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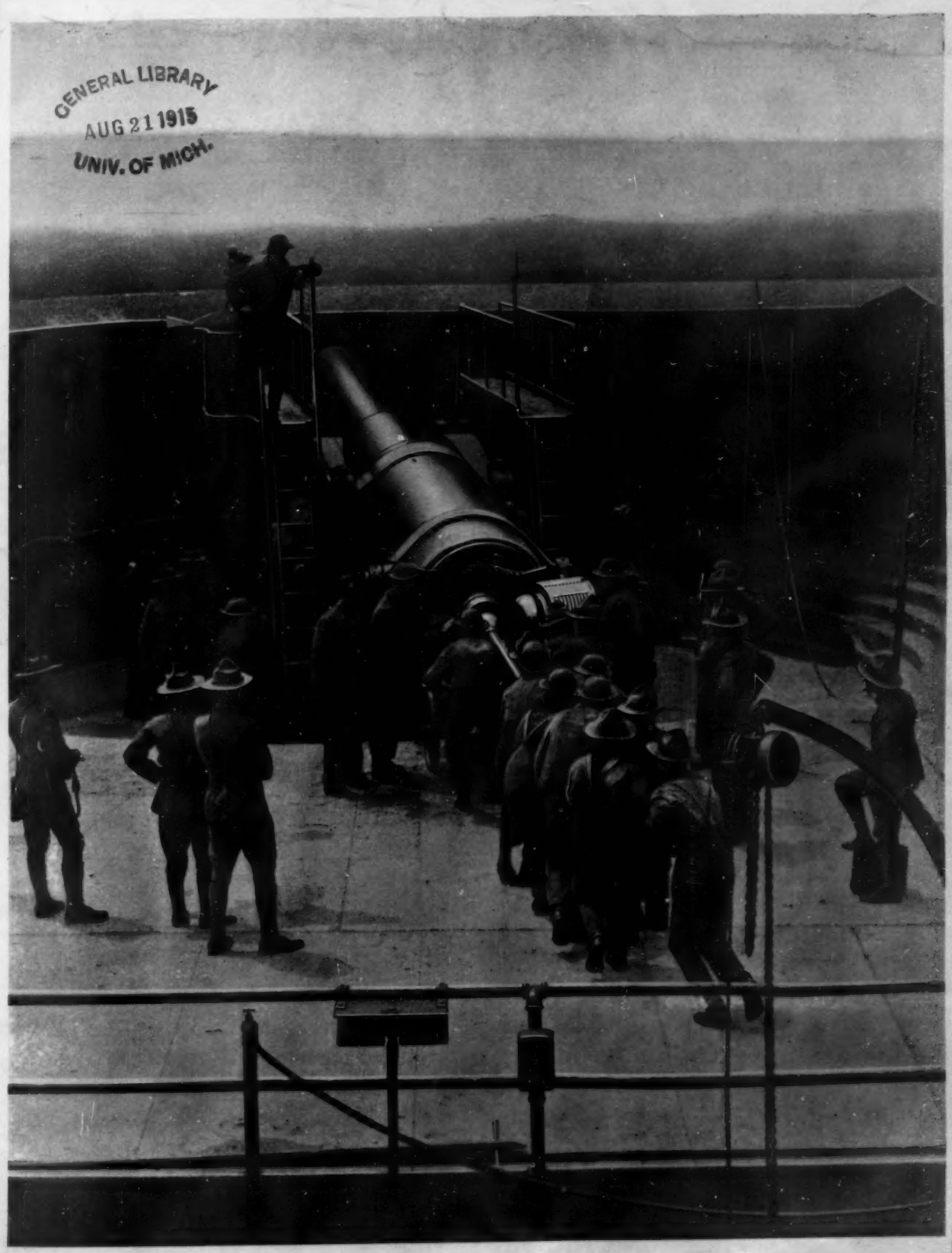

LOADING THE SHELL INTO A 12-INCH DISAPPEARING COAST-DEFENSE RIFLE.—[See page 159.]

Vol. CXIII. No. 8
August 21, 1915

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New York, N. Y.

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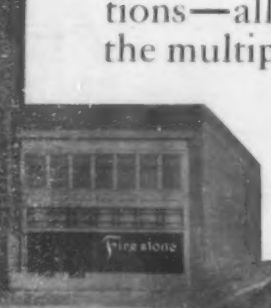

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIII. NUMBER 8

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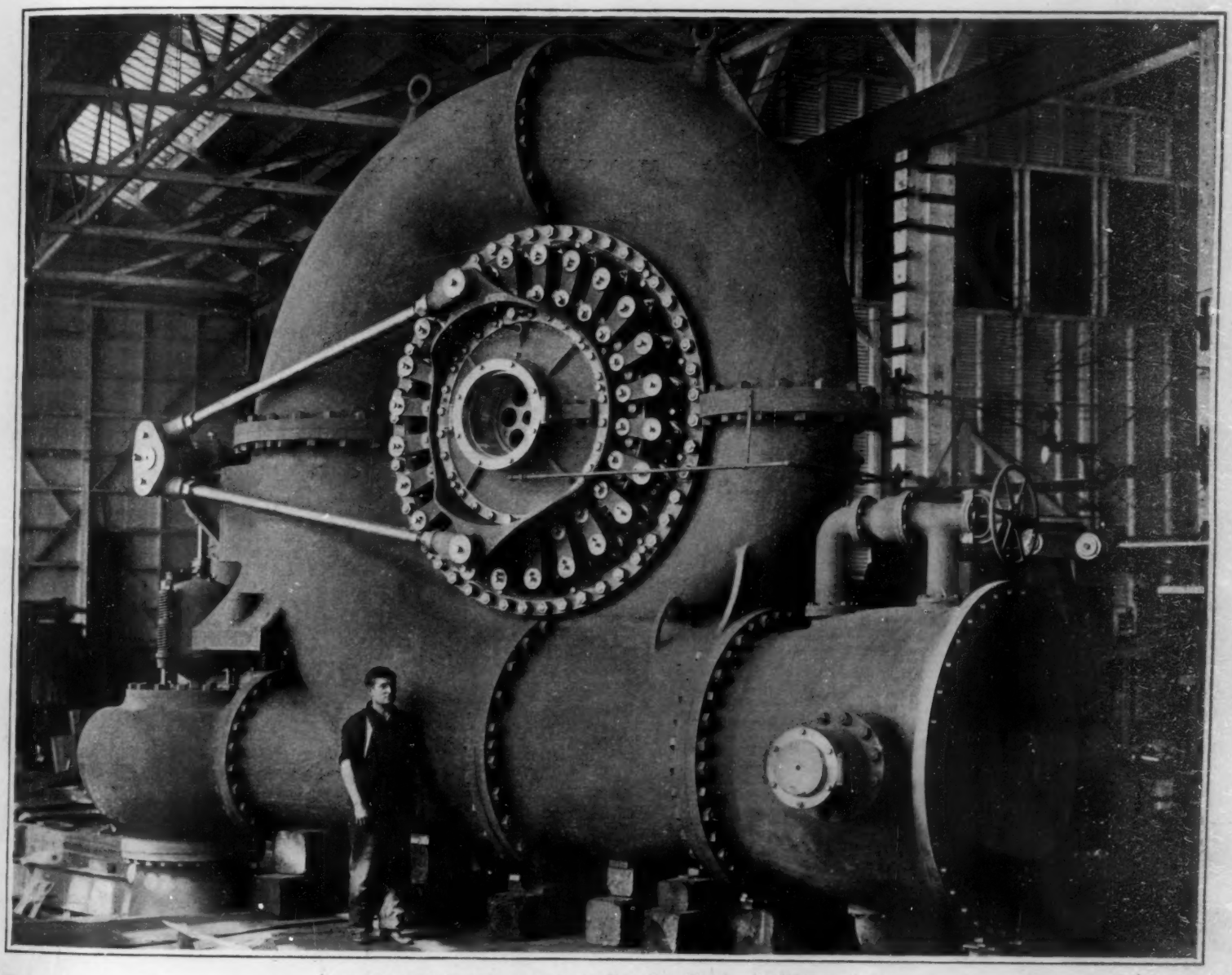

A ten thousand horse-power water turbine at the Panama-Pacific Exposition.

The Largest Hydraulic Motor

ONE of the striking exhibits to be seen at the Panama-Pacific Exposition is an immense hydraulic turbine motor rated at 10,000 horse-power, which is one of several that are building for a California light and power company, and which are said to be the largest single discharge turbines ever built.

Something of the size of this giant may be gained by a comparison with the figure of the man standing beside it, and from the fact that the butterfly valve that is seen at the right of the picture, and which regulates the admission of water to the turbine, is 66 inches in diameter, and requires a ten-horse-power electric motor to operate it. This big turbine is built on the reaction principle, and runs at a speed of 360 revolutions a minute, under a head of 519 feet, and under these conditions approximately from 400 to 465 cubic feet of water pass through the wheel every second. The mechanism seen in the center of the picture is an arrangement for regulating a series of wicket gates that regulate the flow of water to the runner of the turbine, and consists of a series of levers connected with the gates, and also with a large ring that can be partially rotated by the two arms shown. The arms are controlled by a governor, and it will be seen that any movement of the ring will effect a corresponding movement of the wicket gates, by means of which the speed of the wheel is regulated.

The electric generators installed in the plant are of a capacity of 12,500 kilowatt-volt-amperes, 6,000 volts, three phase, sixty cycles, and it requires two of the above hydraulic turbines to drive each generator.

Photographic Determination of Stellar Parallaxes With the 60-inch Reflector of Mount Wilson Observatory

THE April, 1915, number of the *Proceedings* of the National Academy of Sciences contains a note by Adriaan van Maanen of Mount Wilson Solar Observatory, Carnegie Institution of Washington, on his determination of stellar parallaxes with the 60-inch reflector of the observatory.

The first successful measurement of a stellar parallax, that of 61 Cygni, was made by Bessel in 1838. Subsequently other determinations were made with the meridian circle, heliometer, and micrometer. The photographic method was introduced by Pritchard in 1886. Results, however, are still comparatively few.

A nearly complete list of well-determined parallaxes, published in 1910, contains only 365 stars. The probable errors of these parallaxes range from 0.004 second to 0.151 second, the mean probable error being 0.032 second. Since then some lists of a few parallaxes with a mean probable error of 0.011 second have been published.

Most of the known parallaxes are those of stars of great brightness or large proper motion, that is, of comparatively near stars. In order to form an idea of the distribution of the stars in space we need the parallaxes of more distant stars, within a probable error of a few thousandths of a second, for the mean parallax of a star of the sixth magnitude and an annual proper motion of 0.1 second is, according to Kapteyn, only 0.018 second.

Hence, an investigation was made to determine the accuracy of parallax measurements with the 60-inch reflector, using five stars of a spectral type, magnitude and proper motion corresponding to a mean parallax of + 0.014 second, according to Kapteyn's table. From ten to sixteen exposures, distributed symmetrically through the year, were made of each star, and the plates were compared directly by means of the stereocomparator, without using any scale. The time of exposure was fifteen minutes, permitting the use of stars of the tenth and twelfth magnitudes for comparison purposes. The measured parallaxes of the five stars range from — 0.009 second to + 0.078 second, with a mean value of 0.020 second; the probable errors from 0.0015 second to 0.010 second, with a mean value of 0.006 second. In three exposures of the star showing the largest probable error, some astigmatism of the mirror was caused by rapid change of temperature.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contribution will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Achilles' Heel of Germany

IF peace were to be declared in Europe to-day there could be no denying the fact that the central powers, Germany and Austria, would be declared by all military experts to be the winners on "points." They seem to be having matters pretty much their own way with Russia in the east, and in the western theater of operations the German offensive-defensive presents an apparently unbreakable barrier against the French-British-Belgian army.

Dismissing the German submarine attack on merchant vessels as having a practically negligible effect on the military situation, it must be admitted that the German naval defensive is thoroughly effective; for if we except the operations in the bight of Heligoland, no attempt has been made by the allied fleets to force the entrance to the Baltic or to the ports and harbors of Germany on the North Sea.

To the highly technical development of modern warfare, particularly in the production of siege and field ordnance and the machine-gun, is to be attributed the apparent deadlock into which the opposing armies in the western theater of war have been thrown. There, at least, the old system of strategy and tactics with its marching and counter-marching, its concealed flanking operations, and its decisive victories achieved between sun and sun, has given place to siege operations in the field, in which, back of the contending armies, there is to be found, not an invested city which can be shelled or starved into surrender, but a whole nation with all its resources available to reinforce and strengthen the actual line of contact at the front.

Nine months of warfare under these conditions in France and Belgium have proved that so terrific is the storm of shell, machine-gun and rifle fire with which the attack can be met from successive and carefully-prepared positions, that it is practically hopeless for either side to attempt to break through the enemy's line in sufficient strength to attempt those great turning and enveloping movements which are necessary, if the opposing army is to be broken up into separate units and destroyed in detail.

Already the development of the Italian campaign, and also of that at the Dardanelles, suggests that here also the opposing forces are moving into the same condition of stalemate which obtains in the battle-line from the English Channel to the Swiss frontier. In Russia, thanks to the traditional genius of the Russians for defeating, by a masterly and prolonged retreat within their own vast interior, the aim of the enemy to secure decisive action, it begins to look as though the results of the summer campaign would be inconclusive.

We stated in this journal at the very outset of the war that either Germany would win, within a period of three months, in a series of swift and overwhelming operations, or the Allies would win after three years of fighting, in which the Teutonic armies ultimately would be thrown upon the defensive. It begins to look as though, within the next six months, or at the latest by the spring of 1916, Germany, unless she can completely break up the Russian army in her present campaign, will have entered upon the strictly defensive period of the three years' war.

Assuming that the Balkan States will maintain their neutrality, it must be admitted that the hopes of the Allies of making a successful offensive are very slim indeed, at least for many months to come—except in the event (of which, it must be admitted, there seem to be at present no signs whatsoever) of the entrance of Holland into the war on the side of the Allies, and the uncovering of the flank of Germany for a blow which, almost the instant it was launched, would reach, were it successful, the very heart of the great German war machine.

Essen, the Krupp gun factories, and the manufacturing districts of Westphalia—the Pittsburgh of Germany—lie within half a hundred miles, and less than that if anything, from the Dutch frontier. Here is the Achilles' heel of this apparently invincible warrior of modern times, and here it is conceivable that a blow might be struck right at the very nerve center of the German armies, and by the capture of the great source of their munition supply, bring about an instant, or at any rate a very speedy, paralysis of their far-flung military operations.

Of course, the Grand General Staff at Berlin are perfectly well aware of these conditions; and it is equally certain that they have made preparations to meet them. But even the German war machine, with the whole economic and moral force of the German people back of it, cannot achieve the impossible.

Let us suppose, then, that Holland, believing rightly or wrongly that a German victory involving the absorption of Belgium would render the absorption of Holland a natural if not inevitable corollary, should secretly throw in her lot with the Allies, intrench her army of half a million men along her border, open her ports—Amsterdam, Rotterdam and others—for the entry of an allied army of a million or more men, and that the combined forces should make a great drive over the intervening forty or fifty miles between the Dutch border and Essen. And let us suppose that, contemporaneously with this movement, the allied forces along every yard of the eastern and western frontiers and in the Italian theater of war, should make a simultaneous and sustained attack of such violence that not a German soldier could be spared to assist in meeting the new peril—suppose all this: would the allied spear drive deep into the heel of the modern Achilles, or would it be found that, even in this surpassing emergency, Germany was not only prepared but invincible?

Why We Need a National Academy of Sciences

UNDER the title "National Academies and the Progress of Research," Prof. G. E. Hale not long ago published in *Science* a series of articles (since collected and republished in a separate pamphlet) which deserve the earnest attention of everyone who is interested in the advancement of science in this country.

The history of the National Academy of Sciences was set forth in great detail two years ago in a substantial quarto volume prepared by Frederick W. True to commemorate the completion by the Academy of its first half-century of existence. Prof. Hale, in the papers just mentioned, also traces the history of this body, but from a somewhat different point of view. He treats at length of its historic relation to older bodies of similar character—to the academies of Europe, which had their prototype in the Museum of Alexandria, and to the earlier national scientific societies of America, such as the American Philosophical Society and the American Academy of Arts and Sciences. He presents by far the most lucid analysis that has yet been made of the National Academy's status, functions, and relations with other societies. Lastly, he canvasses fully the Academy's needs and prospects.

Without repeating what Prof. Hale has said in these scholarly essays, we shall perhaps not be deemed presumptuous if we offer an independent suggestion or two on the subject that he has discussed with so much acumen.

The National Academy, after a half a century of rather suppressed existence, has lately embarked upon a career of vigorous activity. It is, therefore, timely to inquire what need there is, in a country fairly bristling with societies devoted to separate branches of science, for an organization of catholic outlook and influential membership, modeled after the great national academies of the Old World, most of which originated before knowledge became highly specialized and before the typical scholar had fully recognized the fatuity of the motto *De omni re scibili*.

In the twentieth century no human being dares proclaim himself a Pico della Mirandola or an Admirable Crichton, but in twentieth century America far too many people of undoubted intellectual capacity are content to cultivate exclusively some one little garden patch in the great field of human knowledge. Over-specialization in science and scholarship is deplorable for more reasons than one. The specialist who does not keep himself tolerably well informed concerning the progress of other branches of knowledge than the one to which he is particularly devoted, will often lose thereby valuable sidelights that might have helped illumine his chosen path. Moreover, since a man's studies are supposed to bear some relation to his happiness and welfare, no one can afford to ignore the cultural advantages springing from a variety of interests. In other words, over-specialization is inimical to both efficiency and personal well-being.

A national academy represents the embodiment, on a conspicuous scale, of the ideals of broad scholarship. The value of the example it holds before the nation is so great that we might wish our own National Academy were not merely "of Sciences," but conformed rather to the type of certain academies in the Old World in which the humanities are as assiduously cultivated as the sciences. This is, however, a debatable point, upon which everybody is entitled to his own opinion.

Selling Arms and Ammunition

WITHOUT taking sides in the question of our right, moral or otherwise, to sell munitions of war to the Allies, the only nations able to get to our market, it is somewhat interesting to note a little history on the subject pertaining to the actions of the nations objecting to our course—Germany and Austria.

Up to the great war, there had not been a battlefield of any importance in 20 years across which German-made or Austrian-made rifles did not hurl their bullets—which, too, probably came from the same source. The British in South Africa faced German-made bullets after the Boer supply of Kynoch ammunition ran out, and this ammunition came from Germany, bearing on its base the cabalistic D W M, and was sold to the Boer agents, and smuggled into South Africa months after the war started.

The Russians fired Krupp-made field guns at the Japanese in the war in Manchuria, and the ammunition for both the field guns and for the rifles came from Germany. Half the bullets hissing across the stricken fields of Mexico in the past four or five years of tribulation have been German bullets. The rifles of the regulars of Diaz came from Germany, or from Belgium under German patents.

The nations of the world use as their instruments of slaughter German or Austrian rifles and ammunition almost without exception. Consider the list, then smile at the indictment of America's course coming from Teutonic sources:

United States; modified German Mauser, made by royalty arrangement of $1.15 per rifle, paid to the Germans by our country. Spain; German Mauser, 7 millimeters. Portugal; Austrian Mannlicher, 6.5 millimeters. Greece; Austrian Mannlicher, 6.5 millimeters. Italy; 6.5 Mannlicher, modified in Italy. Servia; 8-millimeter German Mauser. Sweden; 6.5-millimeter German Mauser, made under royalty arrangement paid to the Germans. Bulgaria; Austrian Mannlicher. Turks; 0.30-caliber German Mauser, made in Germany and furnished, with its ammunition, to the Turks all during the Balkan war. German-made ammunition has been used in the last fifteen years by the Turks. The new British service rifle, a modified German Mauser, is made in England. Argentina, Chile, Brazil, and practically all other South and Central American countries, use German Mauser, and German ammunition.

Both Germany and Austria have supplied the world with its instruments of slaughter for a score of years, both in and out of times of war, nor was any line drawn as to the state of things so long as the money was safe on delivery of cargo. The huge Mauser and Mannlicher factories in German and Austria, and the Krupp works in Germany, built up their fortunes on the quarrels of other nations—and the countries sheltering these concerns in objecting to the sale of arms by the United States, put to shame the story of the pot and the kettle.

Fire Alarm System and Insurance

HOW intimate is the relation between fire insurance and the quality of municipal fire protection is shown by the fact that the installation of the new fire alarm system for the Borough of Manhattan, which has just been approved by the Board of Estimate and Apportionment, is to be followed by a reduction of one per cent in the rate of the New York Fire Insurance Exchange, the exchange having made a formal offer of this reduction in case the new system should be adopted and installed.

How mutually profitable to all concerned will be the new installation will be seen, when it is stated that this reduction in rate will more than equal the interest charges of the cost of construction of the new fire alarm system. That the old system now about to be replaced is faulty is shown by the fact that in 1914 every circuit was at one period grounded sufficiently to necessitate emergency repairs, there being no less than 611 such grounds in that year; also 87 per cent of all the circuits went "open" at some period during the year. During the same period there were 507 cases where alarms transmitted from the Central Office to apparatus houses failed so badly as to require emergency repairs.

Electricity

Inland Weather Forecasts by Radio.—The distribution of marine weather forecasts and warnings by radio-telegraphy is now an old story, but the use of this method of conveying weather information to inland dwellers is about to be tried for the first time in this country. Arrangements have been made to send out a wireless forecast daily, between 12:45 and 1 P. M., from Illiopolis, Ill., to all receiving stations within a radius of 125 miles. The messages will be sent slowly (10 to 12 words a minute) for the accommodation of amateur operators who are not sufficiently expert to receive faster.

World-wide Cooperative Observations in Wireless Telegraphy were planned by a committee of the British Association for the Advancement of Science, which reported at the Australian meeting last Summer that the project had been cordially embraced throughout the British Empire and in other countries. A variety of statistics were to be collected three days each week, and suitable forms had been distributed on a large scale. The outbreak of the European War, however, wrought havoc with this undertaking, which had promised to throw light on several obsecure questions in radio-telegraphy, and only a few stations in India, Australia, Canada, the West Indies, and the United States are now keeping up the work. Private wireless stations throughout the British Empire were either dismantled or taken over by military authorities, while naval and other official stations stopped all purely scientific observing. Similar conditions prevailed in the other belligerent countries. The same circumstances led to the complete failure of the extensive scheme of special observations planned in connection with the solar eclipse of August 21st, 1914, except for a few observations made in Norway and Sweden.

Ozonizers in Paris Waterworks.—In order to operate the new waterworks in the suburbs of Paris for sterilizing water of the Marne river with the ozone process, there is erected an elaborate outfit of electric apparatus for supplying current and for the production of ozone. Three-phase current comes from the suburban circuit at 5,000 volts and 50-cycle frequency, and on the cables are connected three transformers of 200 kilowatt size which supply low-tension current at 110 volts. All the motors of the plant are run upon this current, and besides the various pumps, etc., the motors serve to drive three alternators, or rather rotary converters, of 70 kw. capacity each, and these convert the three-phase current to single-phase current of 220 volts and 500 frequency; for the ozonizers require single-phase current. But this is raised by sets of transformers to a high tension of 15,000 and 8,000 volts for use in the ozonizers. The plant contains five batteries of one type of ozonizer and eight batteries of another. In the former type, using 8,000 volts, each battery contains sixteen elements made up of glass plates of large size, coated with tinfoil so as to produce the electric discharge between the plates. Water cooling, by a suitable arrangement of water jackets, is provided for the pairs of plates, and the air passes through the spaces so as to become charged with ozone. Each battery of ozonizers is mounted in a closed chamber with plate glass sides, and the air passes through this chamber and then goes to the water tanks for purifying the water. The batteries of the other type of ozonizer, are made up of concentric cylinders instead of flat plates, and are also provided with water cooling. They operate on 15,000 volts. The new plant can treat 2,500,000 cubic feet of water daily.

High Tension Insulation.—Of course no insulating material can support an unlimited charge without breaking down. The limit is about 21,000 volts per centimeter thickness for air, 100,000 for oil and 600,000 for mica, with alternating current. In a recent paper read at Hamburg, Engineer A. Matthias points out that there is quite an analogy between the destructive effect of electric discharge and that which occurs by mechanical means, and the conditions of dielectric resistance need thorough study. Security is obtained by good insulation in the same way as by good mechanical strength. Temperature seems to have but little effect here, at least in itself, but mechanical or chemical changes might come from this cause and thus change the insulation. Influence of moisture is very great, and sometimes mere traces of water will render the substance useless. This is seen in the case of transformer oil, and only 0.1 per cent water in the oil is found to reduce the dielectric resistance to one-half. Great care must be taken to free the oil from all traces of water. In the same way, coils or windings of dynamos, etc., must be well dried. A point to be noticed is the influence of the duration of the discharge on the resistance, and this is important in practice. In gases, the disruptive discharge occurs almost instantly, but solid bodies retard it, so that a momentary charge can be much stronger than a permanent one. This property is much less in the case of liquids. As the over-tensions which occur in practice are generally of short duration, this property acts to protect solid insulation. But charges applied too long are apt to cause permanent deteriorations of the material, hence, insulation tests should not be made for too long a time.

Science

Dogfish as a Fertilizer.—An article in the *Canadian Fisherman* reports the progress that the Canadian Government is making in its efforts to utilize the dogfish for the manufacture of oil and fertilizer and thus reduce the menace to fisheries. The feasibility of this plan is said to have been fully demonstrated at factories established at Canso and Clark's Harbor, Nova Scotia, and at Shippegan, New Brunswick.

The Nineteenth International Congress of Americanists, which was to have been held in Washington in October, 1915, but was postponed on account of the European War, will, according to present plans, meet in Washington December 27th-31st, 1915, in conjunction with the anthropological section of the Pan-American Scientific Congress, the American Anthropological Association, the American Historical Association, the American Folklore Society, and the Archæological Institute of America. Unfortunately, the prospects are that but few European delegates will attend.

A Distant Effect of the Trade Winds.—Mr. P. H. Galle, of the Netherlands Meteorological Institute, has apparently established an interesting relationship between variations in the strength of the northeast trade winds and fluctuations in water level in the North and Baltic Seas. Means derived from the readings of tide-gages on the shores of these seas show an annual period in water level, with a maximum in autumn and a minimum in spring, the range being about 7 inches. These variations may depend upon variations in the strength of the North Atlantic current, or Gulf Stream drift, which, in turn, depends upon the strength of the Gulf Stream, while the latter appears to be related to the strength of the trade winds. Mr. Galle finds rather a close correspondence between the monthly range in the strength of the trade winds and water levels in the above-mentioned seas, with a time-lag of about two and a half months. In the case of the Baltic the effect is, however, complicated by that of local winds at the entrance to the sea.

An Effect of High-explosive Shells, described by M. R. Arnoux before the French Society of Civil Engineers, and reported in *Nature*, explains the death without actual wounds of persons near their place of explosion. Evidence furnished by a pocket aneroid barometer exposed to the effects of a German shell shows that the explosion produced, at a distance of 10 feet, a sudden barometric depression of nearly 14 inches, corresponding to a driving velocity of the air of more than 900 feet per second. The suggested explanation of the death of soldiers under such conditions without wounds is that "the air and carbonic acid in solution in the blood are disengaged in the shape of minute gaseous bubbles as soon as the pressure decreases too suddenly from any cause. These bubbles are driven into the small arteries under the influence of the pressure exerted by the heart. If their diameter is greater than that of the small arteries, they form so many gaseous plugs, which instantaneously stop the blood circulation, and death occurs before there is time for them to dissolve back into the blood."

Changes in Bird Life in Illinois.—An interesting comparison recently made by Mr. Robert Ridgway of the present conditions of bird-life in southern Illinois with those prevailing half a century ago, is perhaps representative of the changes that have occurred in other fully settled portions of the United States. With a few exceptions the native birds have greatly decreased in numbers. At least three species—the passenger pigeon, wild turkey and ruffed grouse—have totally disappeared from the above-mentioned region, and many other species are on the verge of disappearance. The few species which have not decreased include the crow, the blackbird, the blue jay, and perhaps the robin. Among the causes of this diminution in most species, besides shooting, reduced breeding and shelter areas, the ravages of birds and dogs, and probably the spraying of orchards, the author notes the rapid spread of the European house sparrow, which now, even on the farms, outnumbers all the smaller native birds combined, reducing their food supply, monopolizing their nesting sites, etc.

Photographic Action of a Plant Juice.—According to Messrs. J. M. Petrie and H. G. Chapman, the dried milky juice of *Euphorbia peplus* acts on a sensitive photographic plate in the dark. Some of the juice was spread in the form of letters on glass and separated by a space of 3 mm. from the photographic plate. Sharp images were produced after an exposure of 14 days, while faint images were produced by as short an exposure as 24 hours. The interposition of black paper, impervious to light, between the letters and the photographic plate, did not prevent the formation of images or diminish their intensity, and the same result followed the intervention of paraffined tissue paper, thin aluminium foil or gold leaf, and thin sheet glass. In an attempt to ascertain the cause of this action, the authors examined the dried juice with a sulphide screen, but no scintillation of particles could be seen. On testing the juice in a gold leaf electroscope there was no apparent increase in the rate of discharge of ionized gases. With a sensitive electrometer no action of the dried juice on ionized air could be detected.

Astronomy

The Society for Practical Astronomy proposes to organize a new section to deal with the teaching of elementary astronomy. A correspondence course in this subject, on a laboratory basis, is a part of the programme. Persons in or out of the society, who are interested in the project, should address Miss Mary E. Byrd, Route 9, Box 77, Lawrence, Kansas.

Scintillation of the Stars.—In an articles in the *Bulletin* of the French Astronomical Society, M. G. Bigourdan, of the Paris Observatory, attempts to demonstrate the identity of scintillation and the unsteadiness (boiling) of the instrumental image. Twilight appears to increase scintillation and decrease boiling, otherwise, it is concluded the two phenomena present a true parallelism.

The Mount Stromlo Observatory.—In the year 1910, the Government of Australia decided to define a spot within the Federal Territory (where the new capital is to be built), the meridian of which should be adopted as the prime meridian of Australia, to serve as the common longitude datum for all state surveys, and to mark the spot by erecting thereon a small astronomical observatory. The site selected was Mount Stromlo. The building was erected, and a 9-inch refractor was installed in it. During 1912-13 a varied programme of observations was carried out to test the suitability of the site for more important work, and the results were so satisfactory that this provisional institution will probably soon be expanded into a first-class observatory.

Recent Measurements of the Aurora.—A preliminary report has just been issued by Carl Störmer on the results of the aurora polaris expedition to Bossekop in the Spring of 1913, concerning which only scattered notes had previously appeared. The observations were a continuation of those made at the same place in 1910, and only about one sixth of the extensive material has yet been worked up. This portion, however, gives about 600 very exact measurements of the altitude of the aurora and of its position in space. Each aurora was photographed simultaneously from the two stations, Bossekop and Store Korsnes, lying 27½ kilometers (about 17 miles) apart, and almost in a north-south line. The author notes that in 1913 there was a very marked minimum of solar activity, and it was to be supposed that the auroral corpuscles proceeding, according to his hypothesis, from the sun would have little penetrating power, and consequently would be stopped high up in the atmosphere. This expectation was confirmed. From the measurements thus far worked up there was found to be a very striking lower limit of from 55 to 60 miles above the earth's surface.

Radial Velocities within the Great Nebula of Orion.—The July, 1915, issue of the *Proceedings* of the National Academy of Sciences, contains a note by Edwin B. Frost, of Yerkes Observatory, University of Chicago, on radial velocities in the Orion nebula, which Fabry and Buisson of Marseilles have recently determined by an interferential method and have found to vary in a manner indicating a general rotation of the nebula. In order to test these results by the standard method, observations were begun last Winter at Yerkes with a prism spectrograph. The radial velocity was inferred from displacements of the prominent hydrogen and nebulium lines. From measures of eight plates, taken during the past eleven years, the region of the nebula, known as the trapezium, was inferred to be receding at the rate of 15.6 kilometers per second. This agrees almost exactly with the value, 15.8 kilometers, which the French observers found for the same region. For several other positions not over two minutes of arc from the trapezium, Frost and Maney obtained values varying from 6 to 17 kilometers. Hence, the nebula must be regarded as "seething with local whirlpools," and, perhaps, rotating as a whole.

Parabolic Orbits of Meteor Streams.—The members of the American Meteor Society, organized in 1911, have already contributed 2,800 observations, from which Charles P. Olivier of Leander McCormick Observatory, University of Virginia, has deduced various interesting results, which are published in full in Volume 2, Part 4, of the Publications of the Observatory, and are briefly reported in the *Proceedings* of the National Academy of Sciences, June, 1915. Parabolic orbits were found for 126 meteor streams, and a connection was established between Halley's comet and the Aquarid meteors, which were shown to follow orbits similar to that of the comet. These meteors, therefore, present one of the best instances of the slow disintegration of a comet. The radiant point of the Orionid meteors was found to be in motion. The complete paper shows at a glance what may be discovered by a few hours' observation at favorable seasons. The National Academy has granted a small sum in aid of the work. The note in the *Proceedings* closes with the following appeal: "For observations of meteors a technical knowledge of astronomy is not necessary. Anyone interested as an amateur is invited to write to the Leander McCormick Observatory. Maps and directions for observing will gladly be forwarded. It is earnestly hoped that a large number of amateurs will assist us in the extension of this work."

The Latest Novelty in Speed Boats

THE rivalry between racing motorboatmen to possess the fastest craft has led to the production of many original designs and experiments, but seldom has there been seen anything quite as unusual as the "Tiddledy Wink," a speed boat recently built for Thomas F. Chesebrough for entry in the Gold Cup races this month.

The daily press has had some very sensational reports of the speed made by the "Tiddledy Wink" on her trials, the statements ranging all the way from 70 to 82½ miles an hour, but of course everyone with any knowledge of boats discounts such reports quite heavily. Whatever her actual speed may be, competent observers have expressed the opinion that this new candidate for speed honors can, on a straightaway course, run away from any boat yet built, which certainly means a very lively gait.

The hull of the boat proper is 19 feet 6 inches long by 7 feet in width, of the regular racing hydroplane model; but it is surmounted by a very light deck, or platform, which extends 2½ feet beyond the hull on each side and for the full length of the boat, making the total deck width 12 feet. This platform is designated by the builders as a "spray or wave-collecting device," but an examination of the accompanying illustration, which shows the side view of the boat in action, does not disclose any particular relations between the platform and the waves; but, on the other hand, there is a decided suggestion of aeroplane wings in this device.

The power equipment is quite moderate for a craft claiming such great speeds, being an eight-cylinder motor developing 250 horse-power, the cylinder dimensions being 5½ by 6¾. This engine drives a single propeller through geared transmission, which is located in the bow of the boat, and which permits the propeller shaft to return under the engine at a suitable angle so that the wheel comes under the stern of the boat. A bow rudder is fitted, and the crew occupy two bucket seats that are placed on the overhanging deck at the extreme stern of the boat, while the engine is placed between the crew seats. A passenger cockpit accommodating two people is provided in the forward part of the boat, in front of the engine, although passengers would not be carried when racing.

It is said that the speedy "Reliance" family originated between an accident and an experiment, intelligently developed, so the present curiosity may live up to the reputation that has been given her; but the prediction is made by racing sharps that the "Tiddledy Wink" will have but a poor chance of winning the Gold Cup on account of the many turns in the course over which the race is to be run this season.

Copyright by Levick

Side view of "Tiddledy Wink," showing hull and overhanging "spray collecting" wings.

Copyright by Levick

"Tiddledy Wink" running at speed. She is 12 feet wide over the deck platform.

The Locomotive of the Future

By Herbert T. Walker

WHEN the huge triplex Mallet engine was put to work on the Erie Railroad, many thought that the limit of locomotive dimensions had been reached, but our engineers say "No." The output of the locomotive engine must be increased. Labor unions give us no rest, and the cost of wages and material is constantly rising. Apparently nothing will stop it, and the only way to meet the situation is by handling the traffic in larger and larger units. By this means, and by this only, can the enormous advance in the price of labor and material be met without a proportionate increase in rates, both freight and passenger.

One of the greatest difficulties encountered by engineers who are called upon to design powerful locomotives arises from the fact that the track gage of our railways cannot be changed. Whether Stephenson's gage of 4 feet 8½ inches is the best gage is open to question. Brunel thought otherwise, and in 1836 he laid the track of the celebrated Great Western Railway (England) to a gage of 7 feet; but the obvious necessity of a uniform gage for English railways gradually forced the conversion of the Great Western Railway to the standard gage, although George Stephenson himself admitted at the time that 5 feet 2 inches would have been a better gage than 4 feet 8½ inches. Other eminent engineers gave their opinion that the standard gage was too narrow for the proper development of the locomotive, and that a gage of from 5 to 6 feet would have been preferable. However that may be, the standard gage is here to stay; and not only this, but the clearance limits of platforms, bridges and tunnels are rigid and unchangeable; therefore the only way in which the dimensions of a locomotive engine can be increased is in the direction of its length.

A bold solution of this problem has been proposed by Mr. George R. Henderson, consulting engineer of the Baldwin Locomotive Works, by whose courtesy the leading particulars of this remarkable design are here published.

By referring to the accompanying illustration, giving a general outline of the engine (some details being not yet fully worked out), it will be seen that the dimensions of this future locomotive are beyond anything hitherto placed on wheels. It will be remembered that the largest and most powerful locomotive in the world is the Erie engine already referred to, and a full description of it was published in the SCIENTIFIC AMERICAN of June 13th, 1914. To compare this engine with the proposed locomotive now under consideration, we will repeat some of the dimensions. The Erie engine with its steam tender weighs 853,000 pounds. The total wheel base measures 90 feet, and the tractive effort is 160,000 pounds.

Like the Erie locomotive, the proposed design includes a pair of cylinders placed under the tender, but with the addition of a third pair under the locomotive proper, thus making a total of four sets of engines, each set driving a group of eight coupled wheels, all of which are 60 inches in diameter. This locomotive will be known as the "Quadruplex," or 2-8-8-8-8-2 type.

The cylinders are arranged so that the first pair (high pressure) will exhaust into the second pair of cylinders (low pressure), and these in turn will probably exhaust into the atmosphere. In this case, some kind of blower will be required to produce a draft. The third pair of cylinders (high pressure) will exhaust into the fourth pair under the tender, and the exhaust steam from this set will pass through a feed-water heater before being discharged into the vertical pipe at the rear of the tender. The high-pressure cylinders are 27 inches in diameter, the low-pressure cylinders having a diameter of 41 inches, and all having a stroke of 32 inches. With a boiler pressure of 215 pounds per square inch, the tractive power of this locomotive will reach 200,000 pounds, or a direct pull on the drawbar of 100 American tons, an advance of 20 tons over the tractive effort of the Erie engine.

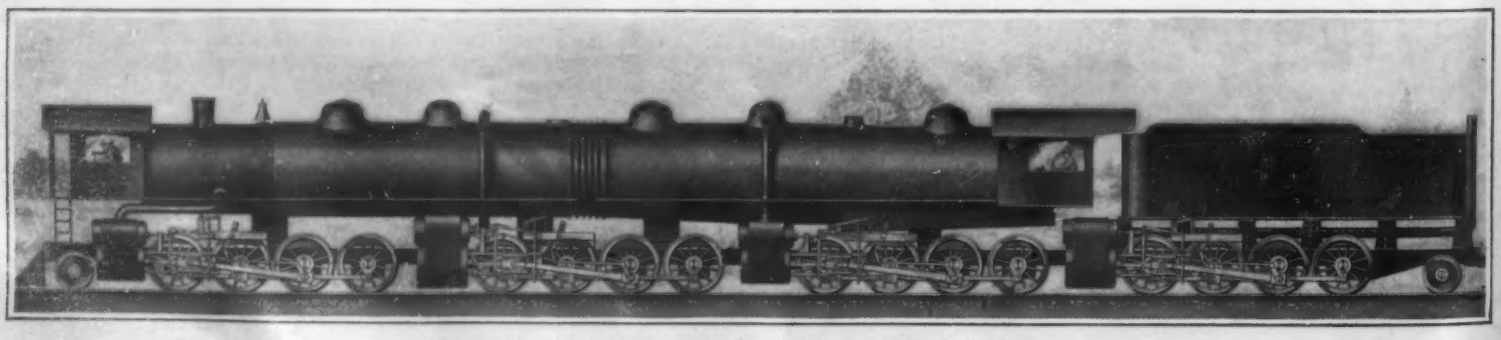
In other respects the dimensions of the new design are no less impressive, for its total wheel base will be 118 feet, or 28 feet longer than the Erie locomotive, with a total length of 128 feet. This great length will not prevent the engine taking the usual curves, for the wheel base will be articulated and the boiler provided with a flexible joint near its middle, where there will be a combustion chamber, dividing the flues into two lengths.

There will be 10,300 square feet of heating surface in the tubes, 50 square feet in the arch tubes, and 400 square feet in the fire box, giving a total heating surface of 10,750 square feet. The superheater will present a heating surface of 1,400 square feet, making the total equivalent heating surface 12,850 square feet, or over 3,500 square feet in excess of the Erie locomotive.

The tender will carry 10,000 gallons of water and 15 tons of fuel, and the total weight of this enormous power plant will be no less than 885,000 pounds, or 32,000 pounds over that of the Erie engine. As regards weight distribution, however, the new design, having 36 wheels, gives only 24½ tons per axle, whereas the Erie engine with its 28 wheels has an axle load of over 30 tons. It may be added that the design calls for the Walschaerts valve gear, a Schmidt superheater, and a Street mechanical stoker. The engine driver's cab will be at the front end to insure a good lookout.

The appearance of this engine and its performance will be awaited with interest.

A Salvarsan Monopoly in Japan.—According to *Commerce Reports*, the Japanese government has decided to undertake the manufacture of salvarsan as a government monopoly, in consequence of successful experiments carried out at the Universities of Tokyo and Kioto, to which institutions the work of preparing the drug will be entrusted.



A locomotive of the future. Tentative sketch of a mechanical Behemoth.

The United States Lighthouse Service

It Never Ends, Either by Night or Day, Summer or Winter

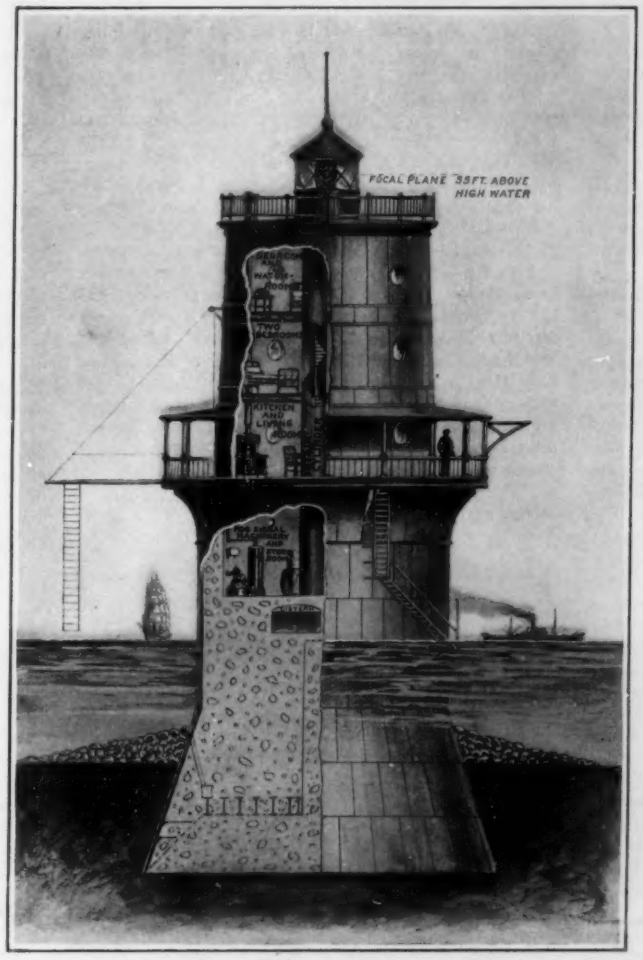
THE work of safeguarding navigation on the coasts of the United States is a far greater and more complex problem than most people appreciate, for there is a multitude of complex conditions to be met, each one varying with the peculiarities of its location. The territory to be covered is also unusually great, as it includes not only the entire ocean fronts of the country, both on the Atlantic and Pacific oceans, but of Alaska, the Hawaiian Islands, portions of the West Indies and the Great Lakes as well; and the service never ends, either by night or day, summer or winter.

This important and indispensable work is performed by the U. S. Lighthouse Service, and we are indebted for the following notes and illustrations to an article by George R. Putnam, Commissioner of Lighthouses, in the *Engineering News*.

The Lighthouse Service comprises a force of 5,600 men, on whom devolves the duty of maintaining over 14,000 aids to navigation of various kinds, including lighthouses, lightships, light-beacons and buoys of various descriptions, together with many fog signals; and an important incidental duty is that of protecting the shores in the neighborhood of stations from damage by erosion that might endanger the structures.

The desirable distribution of lights and other aids along a coast depends on its maritime development and its physical characteristics, and is influenced by the prevailing meteorological conditions. Thus the North Atlantic coast has a large foreign and coasting trade, and the shores are intricate and in part rugged, and along this coast the main lights are, with few exceptions, placed at such intervals that their arcs of visibility overlap. On portions of the coast of simple contour, and with smaller traffic, there are unlighted stretches between the lights which stand on the projecting capes.

The design and construction of lighthouses varies with their location and the surrounding conditions, no two being exactly alike; but the most interesting classes are those which are located on some submerged shoal in the open sea, for here great ingenuity is required not only to produce a structure that can be relied on to meet the special and peculiar conditions that prevail in that locality, but usually great engineering skill is necessary in the work of building in exposed positions. One of the most recent lights of this latter kind is that under construction at Thimble Shoal, in Chesapeake Bay, which is shown, partly in section in one of the illustrations. This consists of a cone-shaped foundation section, 42 feet in diameter at the base and 30 feet at the top, which is sunk 12 feet 9 inches into the sand. Upon this is erected the body of the shaft that rises 20 feet above the water, where it spreads out to a diameter of 38½ feet at the deck, the outward curve tending to break and turn back the waves during a storm. The greater part of this lower section of the structure is filled with concrete, and it supports a three-story cast-iron dwelling, upon the roof of which is located the helical bar lantern, whose focal plane is 55 feet above high water. A fog signal apparatus is installed in the basement, consisting of a trumpet furnished with air by kerosene engines and compressors.



Thimble shoal lighthouse, partly in section to show interior arrangement.

Next to the lighthouse, the lightship is one of the most picturesque objects seen along our coasts, and one of the accompanying illustrations shows the character of the most recent vessels built for use on the Atlantic coast. This vessel is 92 feet on the water-line, 25 feet beam, and has a draft of 11 feet 4 inches. It is built of steel and incombustible materials throughout, and has five watertight bulkheads. It is self-propelled, being provided with an internal-combustion, oil-burning engine of 200 horse-power, and has an oil vapor or gas light 50 feet above the water, located on a tubular mast, through which access to the light can be safely had in any weather. The fog signal is a siren using compressed air, and a submarine bell is also fitted. Fifty-two light vessels are maintained, and that there may be no interruption of the service, there are fourteen relief ships, so that if anything happens to a ship or station another can be quickly sent to take its place. All of these vessels are very strongly built to enable them to withstand the severe service they are required to perform, and have flush decks for increased safety.

New light vessel of improved and powerful design being built for service on the American coasts.

Only one light, that at Navesink, N. J., is equipped with electric light, for which current is generated at the station, but there are thirty minor stations where electric lights, either incandescent or arc, are used, which obtain current from outside sources. In most of the coast lights oil-vapor lamps are used having mantles of either 35 or 55 millimeters diameter, and arranged either singly or in groups, giving light intensities of from 600 to 2,500 candles. These lamps are not only very powerful and reliable, but are much more economical than the old oil-wick lamps, as they require but from 0.6 to 0.88 gallon per candle-power per year, as against 4.8 to 7.6 gallons for the old oil lights. The increased illuminating efficiency is about eight times.

Beacons, both fixed and floating, are numerous, and depend on either gas or electricity for their lights, and these are especially valuable in inaccessible places where attendance is difficult. These, however, are only put in stations of subordinate importance. The majority of such beacons use gas, and are provided with tanks of sufficient capacity for storing a supply of acetylene gas for about five months.

Fog signals are of particular value in many places, and these are distributed along the coast, according to conditions prevailing; thus, on the coast of Maine there is an average of 1,057 hours of fog during the year, while on the South Atlantic and Gulf coasts the average is only 180 hours. There are 328 fog signals from Cape Lookout northward out of a total of 567 maintained by the service. There are 127 fog signals on the American shores of the Great Lakes and 83 on the Northern Pacific and Alaska shores, while in Porto Rico and Hawaii, where fog is rare, no signals of this kind are required.

The principal fog signals used are air sirens, steam whistles, reed horns, bells controlled by clockwork, and submarine bells operated by compressed air, all of which are valued by sailors.

Strategic Moves of the War—August 11th, 1915

By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

WARSAW fell during the week covered by these notes and the tide of Teuton invasion swept by it to the eastward. Novo-Georgievsk, guarding Warsaw to the northwest, has been invested, and before these notes are printed a similar fate probably will befall Ivangorod unless the Russians abandon it. The railroad through Lublin and Chelm is in German hands almost to Kovel, and the Germans are pushing on to capture this important railroad junction. The struggle on the Narew has become even more fierce, and the Germans in this section are getting ever nearer the important trunk line railroad from Warsaw to Petrograd through Bialystok and Vilna, and farther north and east, toward the Gulf of Riga, the German left wing is slowly but steadily bending back the Russian right.

Yet the Russian army is still intact, working to the will of its able commander, making the Teutons fight desperately for every mile gained, and taking from them a heavy toll in life and treasure. The withdrawal of the Russian army from the Poland salient, in the face of the most powerful effort yet put forth by the Germans, gives to its leader a secure place among the great commanders of military history, and warrants the prediction that the Russian army may yet succeed in disentangling itself from the meshes of the net so skillfully set for it.

A few weeks ago the most advanced portion of the Russian line was to the west of Novo-Georgievsk, and the Germans were before Chelm to the south and Ossowetz to the north. If Warsaw and Poland were to be abandoned, Brest-Litovsk was the nearest point on which the retreating Russians could rally. From Novo-Georgievsk to Brest-Litovsk the distance is one hundred and twenty-five miles, from Ossowetz to Brest-Litovsk the distance is one hundred miles, and from Chelm to Brest-Litovsk the distance is but sixty miles. The Russian leader's task has been to hold back the powerful German forces pressing north and south from Chelm and Ossowetz long enough to permit of the orderly withdrawal of immense numbers of men and vast quantities of supplies for a distance of more than a hundred miles.

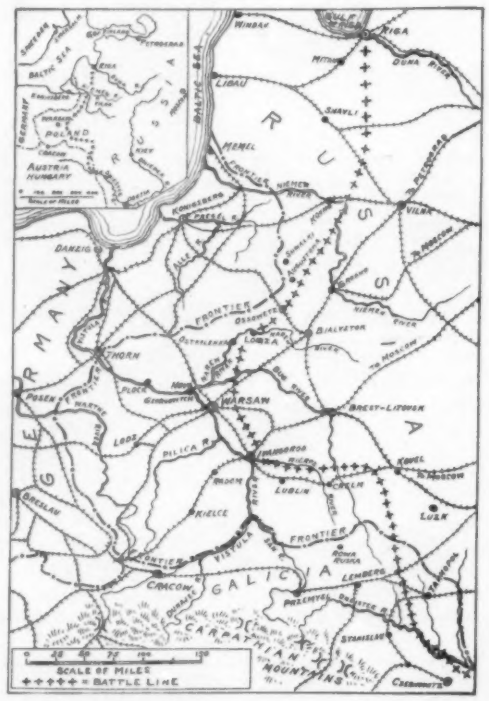
When the announcement was authoritatively made that Warsaw was to be abandoned, the prediction was heard on all sides that the retreat would result in the capture by the Germans of many thousands, if not hundreds of thousands, of prisoners, to say nothing of guns and other war material, but this has not proven to be the case; on the contrary, the Russian army has eluded the effort of the Germans to envelop them even more successfully than they have avoided disaster prior to this in less critical periods of the campaign. It scarcely seemed possible that the Russian army, shaken in *morale* by a continuous retreat of more than two months, disorganized by one serious defeat after another, depleted by the loss of hundreds of thousands of prisoners, and ill-supplied with guns and ammunition, could withstand the onslaughts the Germans have made against it from many directions for the past three weeks. No more splendid exhibition of defensive fighting can be found in all history.

But the best of troops will reach the breaking point if submitted to the strain long enough, and no one should be surprised if at any time the right wing of the Russian army should begin to crumble and disintegrate. The dam that holds back the flood may look strong enough, but when undermined and honeycombed it will break without warning. War is a game of psychology as well as of force, and a commander may at any time deliver the blow that will strain his opponents beyond the breaking point and open for him the flood gates of disaster. Such a turn of events is perfectly possible in this campaign. If we knew more of the actual conditions in the two opposing armies, we might forecast the probability of this with greater certainty. It was one thing to thrust the terror of defeat and disaster upon the comparatively short battle lines of but a few years ago, but it is quite another matter to spread terror throughout a battle front stretching across all western Russia, or even so much of it as would account for more than a mere local defeat.

In fact, this campaign in Russia has shown how very nearly impossible it is to break through a battle line hundreds of miles long. Time and again since the Germans started their drive from Cracow through Galicia, in the early days of May, they have appeared to be on the point of piercing the Russian line, but the elasticity of the seemingly continuous line has enabled it to give and stretch, until support has reached it from other sections and saved the day. Repeatedly the line has caved in, first here, then there, but it was never pierced, and soon after taking Lemberg, the Germans undertook their present campaign against Warsaw and Poland in an effort to break the Russian line by a new method. This new plan was an audacious effort literally to pinch a vast section out of the line by a simultaneous advance against Brest-Litovsk from north and south, well to the rear of some two hundred miles of the Russian line about Warsaw.

By their masterful retreat from Poland the Russians are countering this move of the Germans and once more saving their army. Again we see the wonderful resisting power and elasticity of the "thousand-mile battle front." To the north and south of Brest-Litovsk, along the Narew River on the one side and along the Wierpz and Bug rivers on the other, the Russian commander has collected reserves from everywhere available, and has kept clear a wide roadway for the retreat of the forces about Warsaw. The very natural outcome of this would be to remove the dangerous Polish salient from the Russian line and give it a straight and safer alinement along the Bug River as far as Brest-Litovsk, and this no doubt was the intention of the Russian commander. Unhappily for him, the German counter moves are rapidly making this impossible.

The Germans probably have already given up hope of securing any vast booty or large number of prisoners from the attack on the Polish salient as originally attempted, and apparently they are now initiating new moves intended to precipitate another crisis. If the pincers which are to tear a vast section from the heart of the Russian line cannot close to the west of Brest-Litovsk, perhaps their jaws can be brought together to the east of that fortress, and with this in view, they are being thrust deeper into the body of Russia. One jaw is being thrust toward Kovel and the other is closing down from the north toward Grodno. If Kovel is captured, an important railroad to Moscow is closed to the Russians, and if Grodno or Vilna is taken, the main trunk line to Petrograd will be cut. The Russians in the Brest-Litovsk section will then have but one remaining line of supply.



The German battle line on August 11th, 1915.

The vital part that railroads play in modern warfare becomes more evident with the successive phases of this campaign. How the German forces attacking the Polish salient from the south were supplied in the region without railroads between the Cracow-Lemberg line and the Ivangorod-Kovel line is still a mystery. The latter line of railroad is not yet of service to the Germans, and will not be until Ivangorod is captured. The German forces operating on this front will then have a line immediately parallel to their rear, and the additional supplies they will receive should enable them to carry on a more violently offensive campaign. To the northeast of Warsaw, the Russians still control the main double track railway from near Warsaw to Petrograd. This line, parallel to the battle line and less than fifty miles in rear of it, constitutes a life-line of incalculable value, and one the Russians will fight fiercely to retain. On the other hand, the Germans are no less determined in their efforts to get possession of it, and if they should succeed, the relative strategic positions of the two opposing forces will be materially changed. The Germans will then have a line of supply parallel to their rear all the way from Vilna through Warsaw to Kovel, with many feeders running to the heart of Germany and Austria, and the Russians, on the other hand, will have lost most valuable communications.

The scarcity of railroads in the region to the south of Riga probably accounts for the Germans' efforts to get possession of Riga and the gulf of the same name by combined land and sea operations. If they contemplate extensive operations in this region, as appears to be the case, they will be badly in need of the gulf and city of Riga as a sea base for receiving vast quantities of supplies shipped by water transports from Germany and for forwarding them to the army by the two lines of railways to the south and east of Riga. So long as operations in this region were of secondary importance, the single line of supply from Libau, which the Germans secured by their capture of Libau some weeks ago, supplemented by such supplies as could be sent overland, were sufficient. But for extensive operations, a more perfect supply system must be arranged either by way of Riga or some other equally satisfactory route.

The capture of the Petrograd railway would furnish the needed line of supply and make the control of the Gulf of Riga less necessary. The most important strategic point on this railroad for the moment is Vilna, and the Germans have already begun their attacks on this fortified city. The capture of Kovno has given them two lines of supply for their armies before Vilna, one coming from Königsberg and the other from Libau. Should they succeed in capturing Vilna, they will have three lines of railroads, one toward Grodno, and two others farther east, with which to supply their armies during their further advance against the Russian right wing. Continued pressure in this region and the withdrawal of the Russians from the Polish salient, combined with the efforts of the Germans along the Narew and Bobr rivers, probably will result eventually in the complete abandonment of the Petrograd double track line from Warsaw.

All our information points to this as the probable German plan. The Polish campaign seems to be a failure, so far as the destruction of the Russian army is concerned, which is the main purpose of the Germans, and a new move with this in view must be executed or the whole vast operation against Russia will be classed as a failure. That the Germans are in an admirable position for this next move cannot be doubted. Their left wing is reaching out farther to the eastward every day to sweep around the Russian right, cut it off completely from the coast and press it to the south. An undertaking so stupendous is none too ambitious for the great German General Staff. Should it succeed, the Russian army would be in a situation much more serious than that which confronted it at Warsaw. The strategic railways of western Russia run generally east and west from Petrograd, Moscow and Kiev, and are intended to support a battle line running north and south. With the Germans making their main advance from north to south, they will cut one life-line after another of the Russian army, turn it away from the heart of Russia, and seriously interfere with its supply. A glance at the insert map shows that a German army at Vilna is already between the Russians and Petrograd, and is almost due west of Moscow, from which it could separate the Russians by an advance toward Kiev. Napoleon's march to Moscow will not be repeated by the Germans if the plans of their General Staff for the strategic envelopment of the Russian right wing should succeed.

What can keep this vast movement from succeeding? The Russians are showing greater resisting power than anyone thought possible, but they may be very near the breaking point, and their ammunition difficulties may be growing worse rather than better. There is nothing to indicate that French and English activities on the western front will relieve the pressure on Russia, for Germany is holding her ground in France. The Italian campaign is at best but a diversion, which probably will not interfere greatly with the German plans in Russia. And whatever the final outcome of the allied campaign against Turkey on the Gallipoli Peninsula, there is slight probability of its succeeding in time to open a new route for supplying ammunition to the Russian army before a decision is reached in the present Russian campaign.

The efforts of the four entente powers, England, France, Russia and Italy, to induce the Balkan States, particularly Bulgaria, to enter the conflict against the Teutons, furnish the Allies with more reason to hope

that the tide may turn than do the operations of their armies on the secondary battle-fronts. But the one condition which may stop the Germans' triumphal campaign, more effectually than any other, is the exhaustion of the Germans themselves. For more than three months they have conducted a tireless, uninterrupted, offensive campaign at high tension, which has no parallel in history. The strain on men, from the soldiers in the trenches to the highest commander, has been beyond the conception of the imagination; the demands made on home industries to supply arms and munitions and other war materials must have been phenomenal. How long can the Teutons keep up this intensive warfare? We are forced to conclude, for the moment, that Germany's probable exhaustion, rather than the Allies' strength, is the only condition that may turn the tide in Russia.

Increasing the Range of Our Coast Defense Guns

IN one chapter of that startling work, "America Fallen," the author describes the reduction of the Boston coast defenses by a fleet of German dreadnoughts, assisted by landing forces operating from the rear. The demolishing of the forts by bombardment from the sea was rendered an easy task for the Germans, because of the fact that their heavy guns outranged those of the Boston forts by several thousand yards. The extreme range of the coast-defense guns being 13,000 yards, the German dreadnoughts (the American submarines having been sunk by a surprise attack in the gray dawn of the morning) deliberately anchored at a distance of 17,000 yards, and aided by the observation of their aeroplanes, proceeded to attack the forts with all the deliberation and absence of interference or distraction which characterizes the target practice of ordinary fleet maneuvers.

Now, in assuming these differences of range, the author, who happens to be the writer of the present article, was entirely within the facts.

When the guns and their mounts for our present system of coast fortifications were designed, nearly two decades ago, they were planned to outrange, by a considerable margin the average naval gun of that period. In those days it was believed that the effective battle range would prove to be about seven to eight thousand yards; and in providing the 12-inch guns of our coast defenses with an effective range of 13,000 yards, it was believed that the fleets of any possible enemy would be held at a safe distance.

During the intervening years, however, the naval gun has been developed to a point of power, range and (thanks to improved sighting and range-finding apparatus) to a point of accuracy of shooting, at long ranges, which were never for a moment contemplated when our system of coast defenses was laid down and the character of its armament determined upon.

The element which limits the range of our guns is the moderate degree of elevation of which they are capable, the maximum being 10 degrees as against a maximum elevation of 15 degrees in the British fleet and as high as 30 degrees in the German fleet. Fortunately, by making a comparatively inexpensive change in the elevating mechanism of our guns, it is possible greatly to increase their maximum range. Thus, the 12-inch 35-caliber rifle, at an elevation of 10 degrees, fires a 1,070-pound shell to a maximum distance of 13,000 yards. If the elevation be increased, as it can be by the change above mentioned, to a maximum of 15 degrees, the range can be increased to 17,000 yards. Similarly, the 12-inch 40-caliber gun with 10 degrees elevation has a range of 14,500 yards, and with 15 degrees elevation it will throw its shell to a distance of 20,000 yards.

It is gratifying to note that the clearly expressed wish of the country that the Administration should at once take up the question of improving our national defenses is having its effect. The President and his civil advisors (at least so the papers tell us in their Washington dispatches) are at last disposed to listen to the warnings of their naval and military experts, backed up as they now are by the country at large—and that they are going to endeavor to get Congress to do something in the matter.

May the Fates (or whoever or whatever it is that determines the actions of Congress) be propitious! If, in this matter of emergency action, Congress wishes to get quick and big results for a relatively moderate appropriation, let it place at the disposal of the Ordnance Department ample funds for making the changes above suggested and so rendering our forts effective against possible attack.

Insurance Against Damage by Aircraft has been inaugurated in German cities near the battle-fronts, according to a report from the American Consul General at Dresden. It covers damage to property caused by projectiles thrown from airships or aeroplanes, and also any damage done by such craft themselves in landing or otherwise.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Substitute for Aniline

To the Editor of the SCIENTIFIC AMERICAN:

Having read in the newspapers of the fact that it seems to be impossible to manufacture aniline in this country at the present time, I would suggest that the following composition be used:

> By substituting for one atom of hydrogen one of nitrous acid, we have nitrobenzine. By the agency of six atoms of water HS, we take away all the oxygen, forming four atoms of water, and have two atoms of hydrogen to unite with the nitrogen, toward forming it into ammonia, and the CH is substituted for the other atom of H, thus forming the base for a dye which I believe would answer for aniline.

This composition was discovered by Fretsch in 1890, a chemist who appears to have been very much interested in alkali dyes, and it occurred to me that the process may have been forgotten.

New York city. WINFIELD S. SHORD.

Chicory Culture During the Civil War

To the Editor of the SCIENTIFIC AMERICAN:

I have just been reading your interesting article in the current SUPPLEMENT on the "Cultivation of Chicory and Its Preparation for Market." As a result I have recalled some memories of my rather remote youth. In the early part of the civil war people of limited means found coffee an almost unattainable luxury. As a result, various substitutes were tried. Rye, roasted and ground, wasn't so bad. The same might be said of brown bread crusts. At this time my father tried raising chicory. I remember that I had to weed the beds, but I cannot remember what the tops looked like. The slender white roots, however, I do recall very definitely. We cut these roots in thin disks which were roasted, pounded in a mortar, or ground. The decoction thereof was an exceedingly bitter drink, which did not appeal to my childish taste at all. However, the elders of the family affected to like it, and later, combined with crusts or rye, it was more palatable.

I do not know that this reminiscence is of any possible interest to anyone but myself, but perhaps it may stir other correspondents who will know whether chicory culture in this country was carried on to any considerable extent at the period which I have mentioned.

Hartford, Conn. F. S. LUTHER.

Enciphering and Deciphering Codes

To the Editor of the SCIENTIFIC AMERICAN:

I note in the SCIENTIFIC AMERICAN of July 3rd, 1915, page 9, an article entitled "Cipher Codes and Their Uses."

The method of enciphering is a somewhat labored and "round about" way of arriving at the same result as that obtained by use of the simple and well known cipher disk. While it adds quite unnecessary difficulties to the work of the encipherer and increases his chance of error, the labor of any unauthorized person into whose hands such a cipher has fallen, and who desires to read it, is in no way affected.

This cipher is one of the very simplest now in use and the finding of the key may be said to be a matter of minutes, only so that the author is wrong in holding that the cipher is impossible of translation.

Let us take, for example, the following cipher:

```
KBYLQ TSIGC QAZYE TQWPS HJTUX
JSJII IDMPK JUWWC PHMJK QLMEC
OIWNG OIWPR ALHJK QDMPI HEOCX
YHJKH XHOPO ZHIKK KHEYP HUWJK
RDNWR UNOIV WXJZQ IHKUR UBYVC
KJMQY BYSYS WXJWK KUSKW OLMRP
THPZR KLSPC OFDLO ZUGUR IUAUX
TYUKD BAPUX OXYCS XAAKR QXNWO
KSTCX IHNGO XBICF IHJCX DUWAT
MDHTW TYIGC IEMIR JWWAC BAAIR
UXJUR DOJOY IEWIC ODIUW OJMQY
RYXYT
```

If this is handed to a good cipher man, he can, by means which we need not discuss here, quickly identify it as having been enciphered by use of a key word, in the manner described or by one of several other similar methods. He can also say definitely, that a key word of five letters was used.

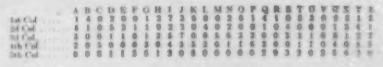
We may say here, that all practicable military ciphers are so marked by characteristic arrangement of the letters that no reasonably expert cipher man will be long in doubt as to the general method of enciphering.

This is especially true of ciphers of the class here considered.

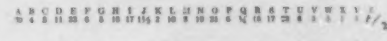
Assuming, then, that we have only to discover the particular five letters composing the key word, we will write our cipher in column, five letters to the line, leaving a space under each letter for the corresponding letter of the message.

We next prepare a frequency table, or list of letters with the number of times each occurs, for each single column.

The result is as follows:



The normal, relative, frequency of letters in English is as follows:



Note the grouping of letters of high and low frequency.

In the normal frequency table a curve commencing at "A" will drop for three letters, rise for one, drop for two, rise for two, etc.

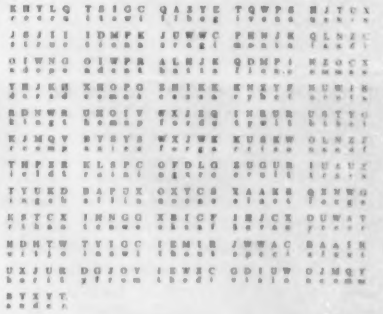
This curve, for the first nine letters in English, is very characteristic and may be relied upon in most cases.

In the frequency tables for the separate columns it shows plainly in all but the first column, and here other parts of the curve are unmistakable. We can see, almost at a glance, that the alphabets used were in reverse order and that in the first column "B" of the cipher equals "A" of the message and that in the other columns "L," "A," "C" and "K," respectively, equal "A" of the message. In other words, our key word is "BLACK."

There is no guesswork about it. The facts are self-evident and, without further delay, we proceed to write the letters of the message in the spaces provided for them.

In this case, a cipher disk was used. Had one not been available, a key, answering every need, could have been prepared in less than five minutes.

Our sheet will now appear as follows, upper-case letters being used for the cipher and lower-case letters for the message:



The completion of this solution, by dividing the message into words, need not be taken up here. The method is self-evident.

For the sake of brevity, I have omitted many points in regard to this cipher, but will cheerfully furnish any additional information, if desired.

It should, perhaps, be stated here that a single short sentence, enciphered by use of a key word, might, and probably would cause the decipherer much trouble. Military messages ordinarily consist of fifty or more words, and these are readily solved if enciphered by some such simple method as the above.

Should a short message be captured, a knowledge of the general method employed by the enemy would aid in its solution, and, possibly, a message of usual length, sent at about the same time, would furnish the key. In any case, these very short messages are seldom used, and the fact that we fail to decipher one cannot be regarded as establishing the security of the cipher or the inefficiency of the decipherer.

Fort Leavenworth, Kansas. FRANK MOORMAN.

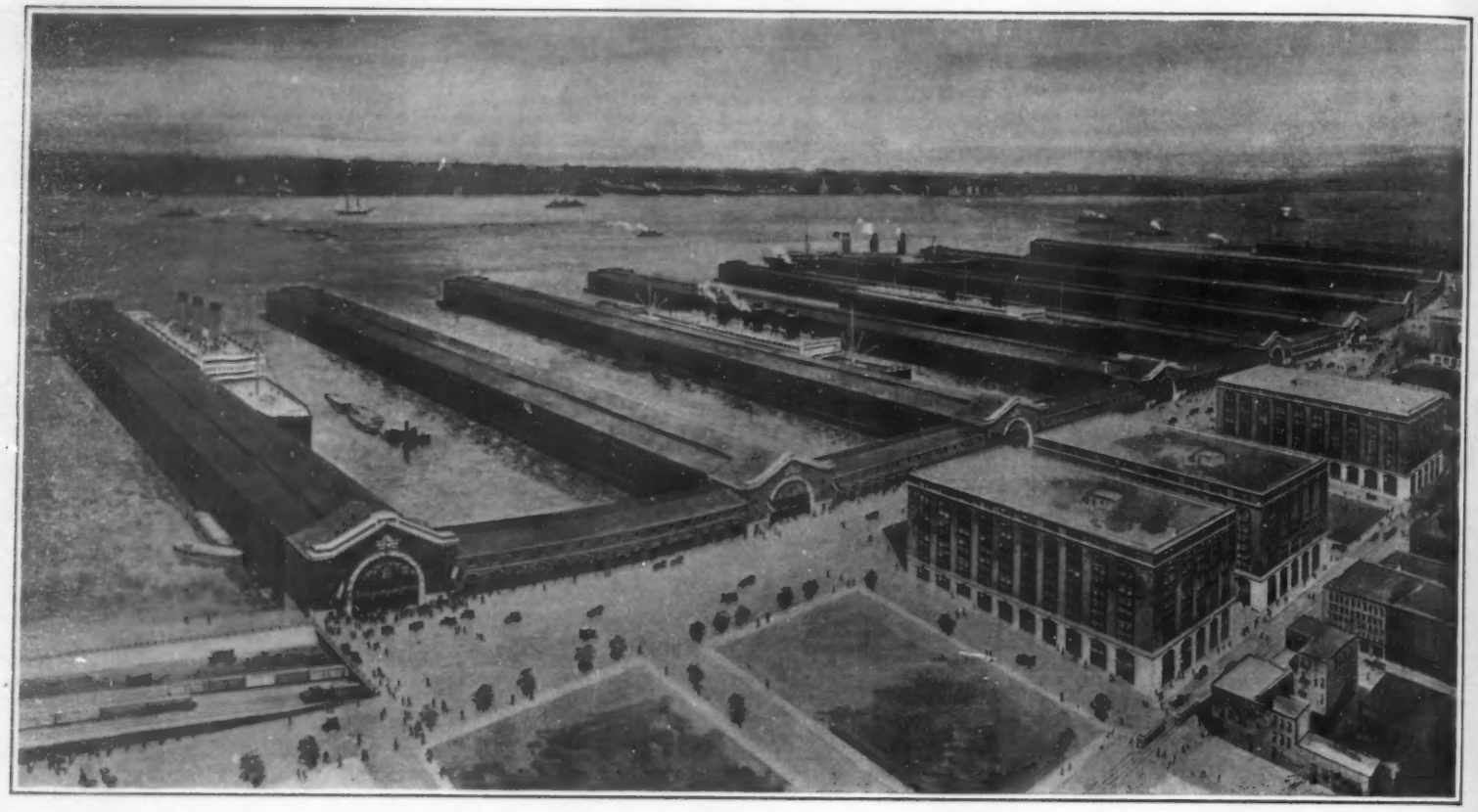
Auroral Lights Becoming Frequent

To the Editor of the SCIENTIFIC AMERICAN:

The aurora, which has been such a rare sight during the past few years, is no longer so, for during the past three months several quite brilliant displays have occurred, and it would be well for those interested to watch the northern skies closely on any clear evening, especially such skies as accompany northerly winds.

We are now approaching the period of maximum frequency which, from advices given from Prof. Carl Stormer, the leading authority on the aurora, will be centered during 1916, when many splendid displays may be looked for. An active display occurred on the night of June 17th, which for a time greatly interfered with the telegraph service and caused great annoyance to wireless operators. DOUGLAS F. MANNING.

Alexandria Bay, N. Y.



View showing how the great piers now being constructed by the city of New York will appear when the project is finally completed.

A Notable Step in the Building of New York's Great Piers

Cofferdamming the North River

By Robert G. Skerrett

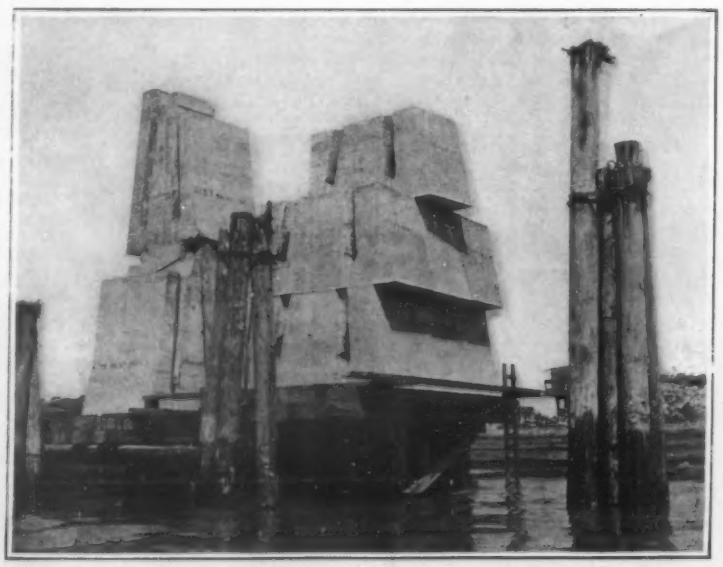
LAST summer we published an account of the proposed cofferdam to be built by the city of New York preliminary to baring an extensive area of the bottom of the North River as a step toward constructing the first of the great 1,000-foot piers for transatlantic liners. The general dimensions of this dam for holding the river's water at bay during the rock excavating and the work upon the pier foundations were given at the time. But, in order to save the reader trouble, it may be best to repeat that the total length of the cofferdam, now finished, is quite 1,100 feet, including a river frontage of 800 feet and a section running at right angles shoreward for 300 feet. From rock-bed up to a point 8 feet 6 inches above mean low water the cofferdam stands 70 feet high, and at high tide it has to withstand a hydrostatic head of 68 feet.

As a matter of fact this cofferdam is meeting to-day physical conditions a great deal more exacting than any similar structures have had to combat. Indeed, it has had but two comparable predecessors: the well-known Black Rock Dam near Buffalo, and the structure built around the old battleship "Maine" in Havana harbor. In the case of the latter the hydrostatic stresses were considerably lower than in the case of the New York cofferdam, while at Black Rock the head of water was just about half that to be reckoned with in the North River. Inasmuch as the pressure of the water increases directly with submergence, at the rate of a trifle over 0.43 pound to the square inch with every foot of depth, it is evident how enormous is the push of the water held back; and this titanic thrust is exerted against the entire length of the cofferdam!

The chief engineer of the Department of Docks and Ferries, Mr. Charles W. Staniford, was confronted with a very serious problem, and precedents were of but moderate value for guidance. Nevertheless, he was sustained by his superior, Commissioner R. A. C. Smith, and despite every allowance made to insure strength and to handle leakage, the department's estimate was actually below that of the highest responsible bidder, and the successful contractor got the job for $487,812. The feature of prime interest now is that the cofferdam has been finished and the inclosed area drained, and so well were the plans made and carried out that a single 4-inch pump is able to take care of the entire leakage and the water coming in from springs that have been uncovered! Just what this means can be better realized when we know that three 12-inch pumps were run continuously to keep down the water that leaked into the Black Rock Dam, which had a hydrostatic head of half that now being dealt with; and at Havana, the first big job of the kind, the large drainage plant was also worked night and day.

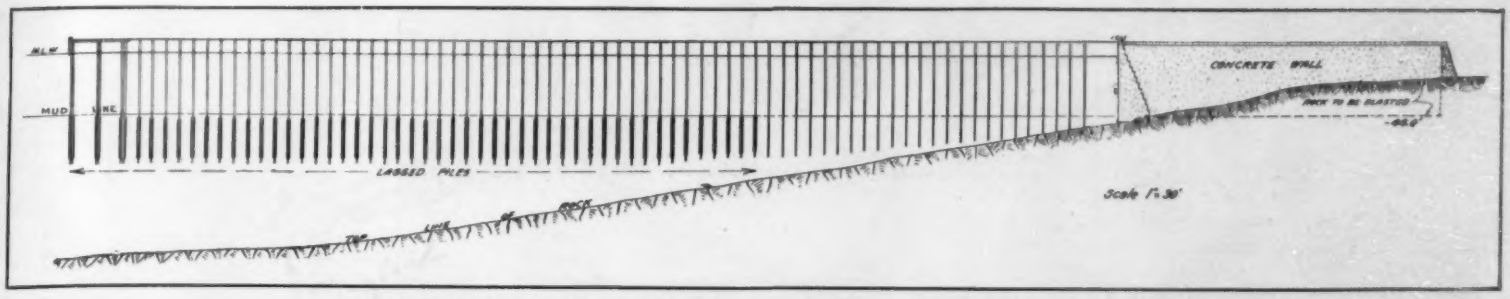
But the foregoing facts do not entirely cover the story of the present engineering achievement. Hydrostatically, the conditions in Havana harbor were nearest to those that concern us now, but the cofferdam about the wreck of the "Maine" was an elliptical structure, and thus had the benefit of the self-supporting element of that form. Even so, it was found necessary to brace the caisson units from within, and at least one girder was sprung across the minor axis in order to give the cofferdam added powers of resistance against the crushing force of the water without. This precaution was not possible with the North River project, and its angular form added to the difficulties and the stresses against which the engineers had to provide in the design. Happily, their plans have proved perfect, the only unexpected development being in the case of the northern inner line of the impounded area, where old cribbing proved unequal to the pressure; but by making holes with 12-inch piles and pressing into these wads of earth, sawdust and manure in successive layers, and capping these with plugs of piling, the leakage was reduced to a moderate minimum. In a short time now hundreds of rock drills will be on the job, and the needful blasting and excavating of rock will proceed rapidly.

An accompanying sketch illustrates in a general way the supporting pier upon which will be reared the two-storied building for the housing of freight and the convenience of passengers. This drawing shows clearly that the greater part of the pile-sustained structure will be virtually afloat, because the rock line at the outer limits is quite 150 feet below mean low water, and the overlying mud is semi-fluid. The engineers have carried out a series of experiments extending over a period of quite nine months, and their first test with a group of simple piles showed that these would not bear the required load without gradual subsidence. However, by "lagging" a similar number of piles, i. e., placing at the bottom of the piles for 30 feet upward, and on four sides, strips squared and 5 by 6 inches in size, it was possible to give these 90-foot pilings sufficient stability to hold permanently aloft a test-load of 220 tons. To put it popularly, this process of "lagging" gave to the group of sixteen piles a sort of web-foot character that gripped the surrounding plastic mud, and afforded the desired resistance to prevent sinking. For these experiments the Department of Docks and Ferries used great concrete blocks regularly employed in New York city for the building of municipal quay-walls as test weights. It must be borne in mind, of course, that this total burden of 220 tons is in excess of the unit overload that will be imposed upon any of these sections when the piers, with their buildings and freight weights, are allowed for.



Testing a group of piles by a weight of 220 tons of great concrete blocks to find how great a load they will support without sinking.

All of this work is but the first step in a gigantic project which will embrace a



Sketch showing construction of bulkhead wall, new 1,000-foot pier, and contour of the river bottom.

group of eight 1,000-foot piers for the accommodation of the biggest transatlantic express steamers, the line extending from Forty-fourth Street north on the west side of Manhattan Island.

A Safe Red Fire Mixture

RECENTLY it occurred to me that I would prepare red fire for the holidays and had recourse to the usual formula books on techno-chemical receipts.

As a result of some quantitative experiments I found some bad defects in existing formulæ as example.

"Holtz's red fire" is a safe mixture being composed of 4 parts strontium nitrate and 1 of shellac, as the nitrate is harmless, but the mixture is slow in igniting and the full effect of the strontium is not seen in the flame.

"Braunschweiger's red fire" uses 9 parts strontium nitrate, 1.5 potassium chlorate, and 3 of shellac, the disadvantage of this mixture is the violet rays of the potassium rather mask the clear red of the strontium and the mixture burns rather rapidly.

The numerous other formulæ were investigated, but the almost universal use of the nitrate of strontium, together with potassium chlorate, and sulphur, did not give the brilliant crimson which the spectroscope shows for pure strontium line.

After an examination of the oxygen requirements of the carbon in some formulæ it was found that an excess or a deficiency existed with which to combine with the oxygen of the strontium nitrate and the potassium chlorate.

It was, therefore, decided to work out a new formula omitting some of the old features and using a strontium salt very rich in oxygen; this was found in strontium chlorate which answered the purpose excellently, but still had the drawback of all chlorates that a mixture of them with carbon are rather dangerous and liable from the general nature of chlorates to spontaneous decomposition when in contact with organic or carbonaceous matter.

New Formula.

NO. 1 MIXTURE.

Strontium chlorate	1,000 parts

NO. 2 MIXTURE.

Wood charcoal (powdered)	250 parts
Starch (powdered)	250 parts
Shellac (coarsely powdered)	400 parts

When it is desired to burn the red fire, No. 1 and No. 2 mixture are poured on a large sheet of paper and intimately mixed on the spot by rolling the powders on the paper by tipping alternate sides until the mixture is uniform.

I find that commercial strontium chlorate contains some moisture, and I get rid of it before powdering the salt, by drying at 212 deg. Fahr. for 24 hours.

When ignited this red fire burns calmly without explosive violence and is not difficult to ignite, the flame is a brilliant crimson, and the formula is calculated to leave a slight excess of carbon after ignition. The starch is used as a reducer of the reaction owing to the emission of water vapor when carbohydrates are ignited. I can recommend this red fire as perfectly safe if mixed in accordance with my directions.

The object of keeping No. 1 and No. 2 mixtures separate until the red fire is actually to be burnt is to prevent any possibility of decomposition of the chlorate starting the ignition of the ready-mixed mass.

Some very curious formulæ were noted in some of the books. For instance, one authority recommends the fusion of the strontium nitrate and the addition of the shellac to the fused mass, the heat melting the shellac and producing a sort of clinker, which is cooled and ground to a powder.

The procedure is evidently very hazardous in its nature, and it is difficult to understand how premature ignition is avoided. With most of the formulæ examined the oxygen requirement of the carbon in the shellac and charcoal has not been calculated and in some cases the large excess of oxygen in the mixture causes the red fire to burn explosively.

No one seems to have considered in any exothermic reaction such as takes place on igniting red fire that substances such as starch or sugar should be present in order that the water vapor from these substances may reduce the violence of the reaction to some extent, but all the old formulæ seem to be written with the idea of having only one powder and for that to burn with some fierceness. As in the case of Holtz's formula the reaction is so slow that a very feeble flame is produced and the energy of the reaction is used up in converting the strontium nitrate into carbonate by its reaction with shellac.

In my opinion most of the formulæ given in the technical receipt of books for red fire have either suffered severely from printers' errors or the authors certainly did not understand the principles of modern chemistry.

The Current Supplement

THE recent passage of a fleet of U. S. warships through the Panama Canal is illustrated in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2068, for August 21st, 1915, by several excellent photographs, one of which is particularly interesting in that it shows three large ships, together with a small yacht, being passed through the Pedro Miguel locks at the same time, two vessels being accommodated in each compartment of the twin lock. Another view shows the location of the annoying Cucaracha slide. A most valuable article in this issue is a report of a lecture by Sir J. J. Thomson on The Conductivity of Metals, in which he brings forward a new theory of the passage of electricity through metals that may prove historic. There is an illustrated description telling how armies get across streams and rivers by means of extemporized bridges and rafts. An Excursus in Geological Time reviews the various theories advanced at different times as to the age of the world, and the applications of chemistry, astronomy and meteorology to the solution of the problem. Uncle Sam in the Movies is a most interesting story, telling how several of the Government departments are using motion pictures for practical purposes. A number of attractive illustrations accompany this article. The Therapeutic Uses of Preparations of the Ductless Glands discusses some experimental investigations of a subject about which little is now known, and will be of value to all readers interested in medical science. There is an illustrated description of some of the hydraulic turbine motors shown at the Pan-Pacific Exhibition, with details of operating and controlling devices. A story of the evolution of the modern dry plate gives an excellent history of the photographic dry plate, with descriptions of the important details in their manufacture, and something of their chemistry. This article will appeal to a wide class of readers. There are notes on a number of valuable new books, and various short articles on various timely topics.

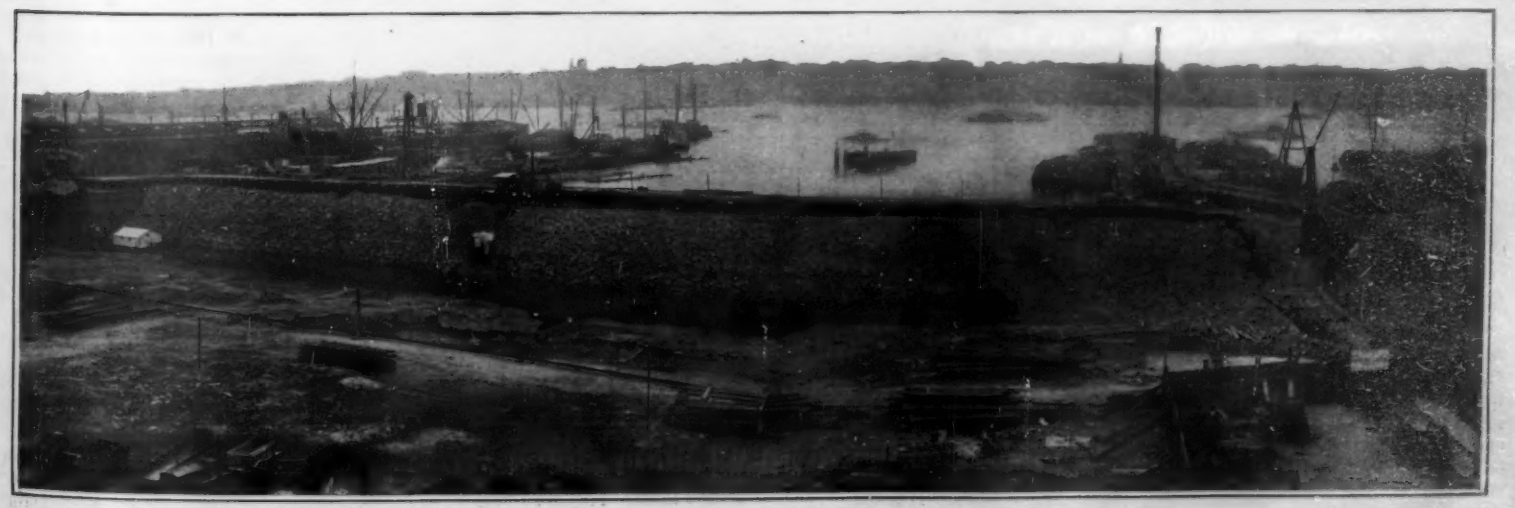
Aeronautical Advisers for the Navy

AS requested by the Secretary of the Navy, the American Society of Aeronautic Engineers has selected, by vote, Henry A. Wise Wood, the president of the society, and Elmer A. Sperry, its vice-president, to serve on the Naval Advisory Board. A co-operating committee, consisting of Orville Wright, Glenn H. Curtiss, W. Starling Burgess, and Charles M. Manly on matters pertaining to aeroplanes and aeronautical motors; Peter Cooper Hewitt, John Hayes Hammond, Jr., and Joseph A. Steinmetz on the application of aircraft to modern warfare; and Capt. Thomas A. Baldwin, A. Leo Stevens, Ralph H. Upson, and Raymond B. Price on the dirigible balloon and the parachute, was also appointed to assist Messrs. Wise and Sperry with their advice in their several departments.

Prof. T. B. Stillman

PROF. THOMAS BLISS STILLMAN, for thirty-five years connected with the Stevens Institute, and widely known throughout the country as a chemist and chemical engineer of eminence, died at his home in Jersey City on the 10th, in his sixty-fourth year. Prof. Stillman was born in Plainfield, N. J., and graduated from Rutgers College in 1876, after which he devoted several years to study in Germany, and later at Stevens, where he was instructor and professor in analytical chemistry until 1903, when he became professor of engineering chemistry. This position he held until his retirement in 1909, as a beneficiary of the Carnegie Pension Fund.

Prof. Stillman was a member of a number of scientific and technical societies, and held several public offices of a technical character in New Jersey. He was the author of a number of books on his specialty, and at the time of his death was at work on a treatise on engineering chemistry, which was to be his greatest effort. It may be remembered that it was Prof. Stillman who gave the famous "synthetic dinner" in 1906.



View within the greatest cofferdam ever built, showing area freed by it from water.

Drying a cut of lucerne.

Farming in Palestine

Agricultural Possibilities of the Holy Land

By Ernest F. Beaumont

Photographs by American Colony, Jerusalem

Photograph American Colony, Jerusalem

Threshing machine used in the Jewish and the German colonies.

A stack of rye.

THE tourist generally enters Palestine by the open port of Jaffa and goes up to Jerusalem by the single narrow gage railway which connects these two places. He crosses the Plain of Sharon, and then the train slowly climbs the mountains of Judea to Jerusalem. In spring, the Plain of Sharon is green with fine wheat fields studded with gorgeous red anemones, and they give the impression of a land of fertility. This, however, is soon lost after the traveler has been in the mountain country for a time. Unless he is a close observer and somewhat familiar with conditions in semi-arid regions, his question would probably be: Where is the land flowing with milk and honey? To really understand the agricultural possibilities of Palestine one must remain some time in the country and study the conditions that here obtain.

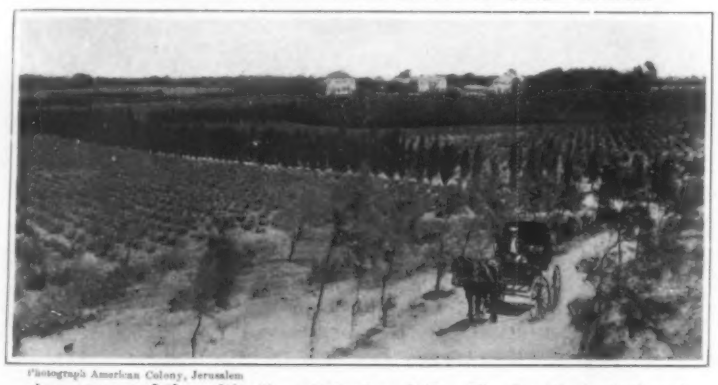
The country is decidedly unique in its physical formation. The deep depression or geological fault known as the Jordan Valley, formed in prehistoric times by volcanic action, divides it throughout its entire length. The formation is of various grades of limestone or Nubian sandstone. In the mountain region of western Palestine the soil is thin except in the valleys where it has accumulated from the washing down of the mountain sides. In many places the old terraces, owing to centuries of neglect, have broken down, and to this is due the great loss of soil from the mountain slopes.

Notwithstanding the fact that the soil is in many places thin, in most cases the limestone rock below is full of large crevices and pockets, where the roots of trees find considerable rich, moist mold. The soil is of a clayey mixture mixed with disintegrated limestone and has a wonderful adaptation for holding moisture, which fact is fully demonstrated by the raising of summer crops, which will be referred to later on.

The next characteristic which gives Palestine great advantages, especially in fruit raising, is the very considerable differences in altitude found in so small a territory. The country lies between north latitude 30 degrees and 34 degrees; that is to say, the latitude of Jerusalem is about the same as Savannah, Ga., or San Diego, Cal. The variation of altitude, and consequently of climate, ranges from sea-level to 2,600 feet above at Jerusalem, and falling to 1,300 feet below sea-level at the shores of the Dead Sea.

The country around Jaffa is well adapted to the growing of excellent oranges, dates, grapes and a number of other fruits, as well as cereals, legumes, etc. This section is underlain by an apparently inexhaustible artesian underflow, which is being utilized for the irrigation of orange groves.

The Plain of Sharon stretches back from the sea for about fifteen miles to the foothills, where the elevation is from five to six hundred feet. On this plain may be grown fine crops of wheat, barley, oats and other cereals. As to fruit, the fig, olive, almond and apricot thrive wonderfully. These same cereals and fruits are grown on the higher elevations, but mature later in the season. The fruit and vegetable market of Jerusalem is, therefore, much prolonged, beginning early in the season and continuing late.



Photograph American Colony, Jerusalem

Appearance of the cultivation attained at Jaffa. The Jewish Agricultural School in the background.

Photograph American Colony, Jerusalem

Plowing in the Beer Sheba District of Southern Palestine.

Photograph American Colony, Jerusalem

The new way of harvesting in Palestine. The modern reaper at work in one of the Jewish colonies.

Last, but far from least to be considered in the agricultural possibilities of this land, is the wonderful Jordan Valley. This locality, though at present practically uncultivated, will no doubt some day become a most prominent factor in the development of the country. It stretches from the Dead Sea northward, a distance of sixty-five miles, to the Lake of Galilee. Going out from this latter lake, the river Jordan, with a fall of 600 feet in sixty-five miles, traverses the entire length of the valley and empties into the Dead Sea 6,000,000 tons of sweet water daily. This valley has been likened to a tropical oasis sunk in the midst of a temperate climate. The altitude, or rather depression, at the Lake of Galilee is 682 feet below sea-level, gradually falling off to about 1,300 feet at the shores of the Dead Sea. Hence, we have a natural reservoir of beautiful fresh water fourteen miles long by eight broad, its greatest depth being 200 feet, with a daily supply of 6,000,000 tons of water, situated at the head of 200,000 acres of deep, rich alluvial soil seated in semi-tropical climate.

It is said by experts that the irrigation of this valley by canals leading along the foothills is quite feasible and would turn the section into a veritable paradise. Here, owing to the great heat, everything grows with surprising rapidity, to an enormous size. Lucerne or alfalfa, under irrigation, produces ten crops a year. Bananas, oranges, sugar-cane, cotton and all the fruits of a semi-tropical climate can be raised. The cotton is perennial in growth and of a long, fine fiber. Fine wheat and barley are also produced. The growing season is prolonged throughout the whole year. The climate, though very hot during the summer months, is most delightful in winter.

East of the Jordan Valley the hills rise again to a height somewhat greater than the western ridge. Eastern Palestine is a great plateau, well watered and fertile throughout its length. This is an admirable wheat-growing district, where as fine wheat fields may be seen as exist anywhere in the world.

This section has very few towns, as most of the inhabitants are nomadic Bedouins. Here a small number of Circassians have established themselves and built villages. They are far more energetic than the Bedouins and cultivate the ground in such a way as to get abundant crops.

Then there is the Beer Sheba district of southern Palestine, celebrated for its fine wheat and barley, which, in a good season, yields to-day, just as in Bible times, a hundredfold. This region is also inhabited by Bedouins, and agriculture is carried on by the crudest methods. It also has an artesian underflow which can be utilized for irrigation. Water is found at a depth of from 40 to 50 feet. Much more might be said of certain other localities, such as the rich historic Plain of Esdraelon and the Valley of Dothan.

which, under proper cultivation, yield as fine crops as the best land in the United States. But this is self-evident to the casual observer. What needs especial exemplification, though well understood by the student of agriculture, is how the now barren, rocky hills can be transformed into productive fruit orchards.

As has been mentioned, Palestine is distinctly a limestone country, and the very stones which the passer-by thinks are the curse of the land are its salvation. In civilized countries it is the practice to fertilize all cultivated land, and were this precaution neglected for a considerable length of time, it would cease to yield profitable crops. This country, on the other hand, has been farmed for thousands of years absolutely without fertilization. Furthermore, the cattle manure is carefully collected from the fields, dried and used for fuel, so that the land is robbed of what little it might get from that material. What saves it is the continual disintegration of the limestone giving the soil that property that enables it to make use of the nitrogen in the air. The nitrogen-gathering bacteria are present in every locality. Moreover, the porous rocks underground seem to hold the moisture throughout the summer, so that it may be gradually utilized by tree roots and summer plants during the long dry season.

Where in the United States or in Europe could a crop of beans, peas, vegetable-marrow, watermelons or cucumbers be raised absolutely without rain or irrigation? But it is constantly done here. When the fellah wishes to plant a summer crop, he lets his land lie fallow during the rainy season, and when he is reasonably sure the rain is finished (because the best result is obtained without any rain at all), he scratches the ground a few inches deep with his crude plow, such as Abraham might have used, puts in the seed, cultivates occasionally to keep down the weeds, and his crop is insured.

In some localities, as Bethlehem, fine olive groves exist, and on land no better originally than thousands of acres at present lying waste and to all appearance worthless. There is hardly a rocky hill anywhere in the country that would not offer good facilities for the thriving of these unique and exceedingly profitable trees. But one asks: If this is the case, why are not these hillsides everywhere green with the olive? For the simple reason that such a ruinous system of taxation has existed for so long that not only has the poor peasant been robbed of all ambition to plant, but is only too glad to cut down these venerable trees and sell the wood for fuel rather than pay a tax that amounts to more than the tree yields him.

The almond is another tree that thrives on rocky soil, and had Palestine a proper government, so that tree planting would be encouraged, no doubt large almond groves would spring into being, as this favorite nut is always in demand, and not being of a perishable nature, is easily handled and exported.

The fig tree probably adapts itself to rocky places better than any other. These may sometimes be seen growing upside-down from the roof of a cave. All fruits are, at present, of common unimproved varieties. The idea is very deep-rooted among the natives that any endeavor to improve on the methods of their forefathers would be the greatest arrogance. And for this reason everything has retrograded rather than improved. "Abraham did it this way—God forbid that we should be better than our father Abraham." However, when the grafting of better varieties is practised the results are most satisfactory.

The matter of rainfall of this country is of especial interest, because during the past sixty years that the record has been kept at Jerusalem by the Palestine Exploration Fund, there has been a steady increase up to the present time from a yearly average of twenty-two inches to twenty-eight inches. The rain generally falls during the six months from November to April. The remaining six months are rainless. There are the "former rains" and the "latter rains." The "former rains" are very heavy and with storms, and come during December, January, and February. The "latter rains" are of a more showery character and are necessary to mature the crops which have started with the "former rains." The natives begin plowing as soon as the first rains have sufficiently moistened the soil.

What would strike the western reader as rather out of the ordinary is that the grape crop, which is probably the most abundant of all the fruits and which includes numerous delicious varieties, is matured entirely without rain or irrigation; in fact, the leaves do not appear before the dry season has set in. What is true of the grapes may also be said of all the summer fruits, including watermelons.

All this goes to show the peculiar property of soil and rock combination which to a great measure so stores up this ample rainfall that it may be utilized by plants during the summer.

Lucerne, grown without irrigation in the valleys, produces three crops a year, and does not suffer seriously, if at all, in living through the long dry season, as the roots penetrate the crevices of the underlying rocks and find moisture. One year it fell beneath the writer's notice that the dry season lasted eight months, that is, this time elapsed before sufficient rain fell to moisten the ground to a depth of three inches, but this hardy plant was not in the least injured.

Around Jaffa and Haifa some few thrifty German colonies have been established, and modern farm machinery is used with very fine results. Furthermore, there are in various localities throughout the country thriving agricultural colonies under the direction of the Jews These were started on funds donated by Baron Edmund Rothschild and other philanthropic Jews of Europe.

Palestine is essentially an agricultural country, as it has absolutely no other resources, and in past times supported a large population. But it should be understood that to restore it to its former prosperity would require considerable capital and a radical reform of government.

Though the Israelites came out of the very productive land of Egypt, their destination was described as a land flowing with milk and honey. This statement is most interesting in the light of facts concerning the production of honey here. It is well known to botanists that Palestine is the meeting-place of the flora of three different continents, and this circumstance combined with the varied altitudes produces a condition most favorable to bee culture.

Some years ago two brothers living in Jaffa went into the apiary business. They conceived the idea of furnishing the bees with material for honey-making throughout eight months of the year by camping first at a low altitude and when the flowers of that locality were finished, moving the hives on camel back to a higher place, thus following up the consecutive blossoming of different wild flowers. They first let them work on the orange blossoms around Jaffa, and this fragrant honey was kept separate as was that obtained from each succeeding flower which pervaded any particular district. Thus, they were able to label their honey "Orange Blossom," "Thyme," etc.

The data furnished by these gentlemen show a yield exceeding that yet known in any other country. By using modern American extracting machinery and replacing the combs, one hundred hives produced six tons of honey during eight months. That is 120 pounds to the hive. The average yield in Australia and America is thirty pounds to each hive and the maximum fifty. From these facts it is clear that this unique land is possessed of great natural advantages over other lands, not only in ordinary agricultural possibilities, but in this interesting matter of producing honey.

An Important Decision on the Clayton Act

JUDGE HOUGH of the United States District Court for the Southern District of New York, has just rendered a decision in the case of Great Atlantic & Pacific Tea Company against Cream of Wheat Company, which should be of interest to all manufacturers of "Standard" advertised merchandise who desire to maintain a uniform retail selling price therefor.

The decision was on a motion for a preliminary injunction to restrain the defendant from refusing to sell to plaintiff Cream of Wheat in carload lots at its wholesale price, such refusal as the plaintiff contended being in violation of Section 2 of the Clayton Act.

It seems that the defendant requests that all retailers shall not sell to the consumer at less than 14 cents per package, and that while the plaintiff bought in wholesale lots, it was not a jobber, but a retailer, having hundreds of retail stores in which it sold Cream of Wheat at 12 cents. As it would not promise not to cut the retail price, the defendant refused to sell it any of its Cream of Wheat, "at any price or in any quantity whatever."

Defendant does not sell to "consumers, retailers or chain of department stores," but confines its sales "exclusively to wholesalers." The sales of defendant "imply no agreement to maintain prices on resale, but as before stated, requested that retail prices be kept at the level recommended by it."

Not only did the defendant refuse to sell to plaintiff, but it requested the jobbing trade to see that plaintiff should not get any Cream of Wheat at any price.

"This condition of affairs still continues; and the main object of this section and of the present application is to compel defendant to fill plaintiff's orders for Cream of Wheat in carload lots at $3.95 per case.

"Of course the bill does not put the matter so boldly (c), but if the law does not warrant an order productive of the result stated, this action is of little worth."

The Sherman Law was not in question, for under that law the plaintiff could not prosecute a bill in equity.

"It is urged that defendant's professed and published scheme of sales, plus its practice thereunder, create an actual monopoly of, and do lessen competition in Cream of Wheat; that this result is in itself unlawful, and is produced by means which are specifically prohibited by Section 2 of the Clayton Act, viz., price discriminations not justified by any of the exceptions of that section. As the next and final step in justification of its procedure, plaintiff asserts itself to be threatened with loss or damage through the above stated violations of Section 2, and therefore seeks an injunction under Section 16."

The defendant did not seek to create a monopoly in Cream of Wheat for it clearly had such a monopoly in and under its trade-mark.

"Taking up seriatim the parts of the above propositions, it is true that the defendant has a monopoly in Cream of Wheat, but, as heretofore stated, it is a lawful monopoly, ultimately resting on the plain truth that there can be nothing anywhere in the United States lawfully called Cream of Wheat without defendant's consent and approbation. In that substance (if legally it is a distinct substance), defendant has the monopoly of a creator, something which is not and never has been within the prohibition of any law anti-trust or otherwise.

"On the contrary, that monopoly is encouraged by patent, trade-mark and copyright statutes and the rules of unfair competition. Therefore the implication of plaintiff's premise that there is something inherently wrong in defendant's monopoly is false and misleading."

The Court says that what defendant has done does not result in fixing the retail price, for "fixing" connotes enforcement; it simply requests that a fixed price be maintained, and to those who refuse to maintain such price it refuses to sell.

"To call defendant's acts price fixing is inaccurate, and evades obvious legal questions, viz., whether defendant has the right to decline business, and whether it is anybody's business why the business is declined."

As to preventing competition the Court said:

"The only competition prevented or sought to be prevented by defendant's acts is that of Cream of Wheat against itself: the only trade restrained is the commercial warfare of a large buyer against small ones, or that of a merchant who for advertising purposes may sell an article at a loss in order to get customers at his shop and then persuade them to buy other things at a compensating profit."

As to the injury to the manufacturers' business from price cutting the Court hits the nail on the head as follows:

"Cream of Wheat is not a necessity; it is not even a staple article of commerce. If it be a commodity at all, the commodity and the name are synonymous. Its continued existence depends upon defendant's ability to control the marketing of its own product. The doing of what plaintiff wishes would take from every groceryman near an 'Economy Store' the last incentive to buy any Cream of Wheat, and collectively such grocery keepers are more important to the public and the defendant than is the plaintiff. If injunction were granted, defendant and many retailers would be injured, and the microscopic benefit to a small portion of the public would last only until plaintiff was relieved from the competition of the fourteen-cent grocers—when it, too, would charge what the business would normally and naturally bear. In short, it is plaintiff and not defendant that pursues methods whose hardship and injustice have often been judicially commented upon (U. S. v. Freight Ass'n, 166 U. S., 321)."

The Court finds that what the defendant has done in the effort to prevent price cutting is not an unreasonable restraint of trade and, therefore, not in violation of Section 2 of the Clayton Act, and because that Act specifically recognizes the inherent right of a merchant to select his own customers, he doubts the right of the Congress to pass a law which will compel a merchant to sell to anyone.

He says on this point:

"(1) Does Section 2 of the Clayton Act apply to the defendant at all? and

"(2) Is it within the power of Congress to compel defendant to do what plaintiff demands?

"Section 2 plainly identifies the lessening of competition with restraint of trade (of the body of the section with the last exception). But price discrimination is only forbidden when it 'substantially' lessens competition. Construing the whole section together, the last exception reads in effect that a 'vendor may select his own *bona fide* customers providing the effect of such selection is not to *substantially* and *unreasonably* restrain trade.'

"How it can be called substantial and unreasonable restraint of trade to refuse to deal with a man who avowedly is to use his dealing to injure the vendor, when said vendor makes and sells only such an advertisement begotten article as Cream of Wheat, whose fancy name needs the nursing of carefully handled sales to maintain an output of trifling moment in the food market, is beyond my comprehension.

"Turning to the second question: If it be granted that Section 2 does apply, and that defendant's selection of customers results in unlawful restraint of trade, can it be possible that such person's evil ways are to be mended not by stopping his business but by adding to his list of customers one or many persons chosen by the Congress?

"Numerous individuals and corporations have been enjoined from restraining the trade of other people, no matter how flourishing the offenders' trade might be nor how greatly the general volume of trade had increased during the period of restraint. But never before has it been urged that, if I, S., made enough of anything to supply both Doe and Roe, and sold it all to Doe, refusing even to bargain with Roe, for any reason or no reason, such conduct gave Roe a cause of action (j).

"If the Congress has sought to give one, the gift is invalid, because the statute takes from one person for the private use of another the first person's private property.

"Using the words sell or sale conceals the issue. If a man prefers to keep what he has, an offer of money to salve the taking thereof does not prevent such taking from being confiscation. The Cream of Wheat Company is a purely private concern, except as regulated by its creating law; it is an ordinary merchant whose business is affected by no public use whatever. The statute as construed by plaintiff descends upon that private merchant, and commands him to make a contract by which he transfers his property for a price, but against his will. The contract and the price are legally mere surplusage; the constitutional violation lies in the compulsion, whereby he is deprived of his property for a private purpose."

All of which goes to show that the Courts are beginning to recognize the great and irreparable injury which may be done to the business of a manufacturer of standard advertised merchandise by the price-cutter.

and that while possibly the law cannot reach such price-cutter and afford any affirmative relief to the manufacturer, yet he has the remedy in his own hands and can lawfully refuse to sell him his goods and induce others not to sell such goods to the price-cutter.

A "New" Surgical Antiseptic

VARIOUS notices have appeared in the daily papers in regard to what is stated to be a new and wonderful antiseptic, said to be used very successfully in France in the treatment of surgical cases. Credit for its discovery is given both to Drs. Alexis Carrel and D. Dakin. This new antiseptic system consists in the application of hypochlorites. As a matter of actual fact the credit for the use of these substances as antiseptics belongs to an American. Their value in medical and surgical use was discovered by Albert E. Woolf of New York, twenty-five years ago, and a reference to his discoveries was made in the SCIENTIFIC AMERICAN of August 5th, 1893, when the Woolf system was adopted by the city of New York for the purification of water. Many other scientific publications at that time contained comments and accounts of applications of this discovery.

All of the valuable results now claimed for the hypochlorites for medicinal and surgical use were developed by Dr. J. Solis Cohen in the home for consumptives in Philadelphia many years ago; and they were also used by Dr. Philip Keyser in the Wills Hospital, Philadelphia, and in the New York hospitals, where they have long been well known. Many special and exhaustive tests were also made in the Hahneman Hospital in New York in abdominal operations, with remarkable success.

In some of the articles now appearing it is claimed that hypochlorite of calcium is the most powerful antiseptic known, but that its use is limited owing to its destructive action on human tissues, due to its acidity. This statement is erroneous, as the hypochlorite of calcium is strongly akaline, and its destructive action, if any, would be due to its strong alkalinity and oxydizing action if used in too concentrated form. The statement is also incorrect for the reason that it is well known that oxygen, or ozone, is the most powerful antiseptic. When European practitioners have more experience they will follow the example of American chemists in getting rid of all insoluble substances, such as lime, the accumulation of which ordinarily produces undesirable results.

The antiseptic properties of the hypochlorites are due to the liberation of ozone when they are decomposed in the presence of organic matter, the action being as follows: The chlorine of the hypochlorite in the presence of organic matter, on account of its great affinity for hydrogen, combines with the hydrogen of the organism, thus liberating ozone, which destroys the organism by oxydation. The chlorine from the split up hypochlorite combines with a base, thus forming a stable chloride that is inactive.

Mention is made in the newspaper reports referred to above of the addition of a certain percentage of carbonate of lime and boric acid to preserve the hypochlorites, but it is well known that the solution of hypochlorite of calcium is so stable in itself that an acid is used to neutralize the alkalinity, and to render it less stable for use in bleaching processes; and the addition of boric acid is not made to render it stable, but to make a solution of hypochlorous acid (see Bloxams Chemistry).

Gas from Sawdust

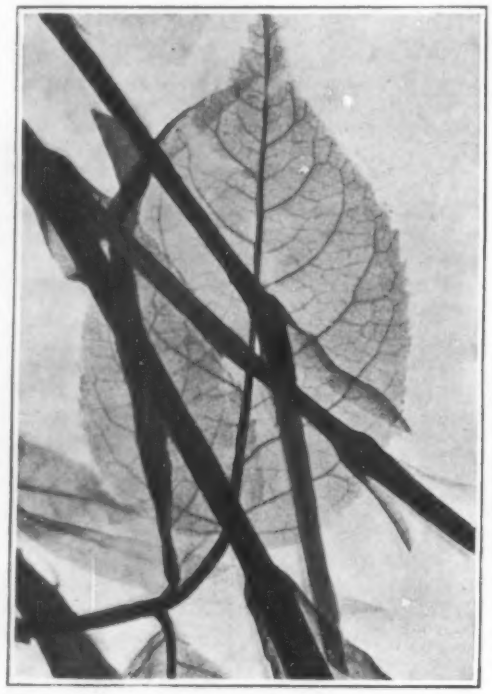
ENGINEERS have taught that wood less than four to six inches diameter could not be distilled in gas making because of its tendency to burn up rapidly when the temperature reaches 275 deg. Cent. Lawrence has just shown that even sawdust can be distilled in gas making if the retort is heated very slowly up to 100 deg. Cent., then a little more rapidly to 280 deg. Cent. and then stopping the external heating until the temperature reaches a maximum, heating again and finishing the distillation by raising the temperature as rapidly as possible to 400 deg. Cent. or a little over.

Antidote for Snake Venom

INDIA'S annual loss of over 20,000 lives from snake bite has forced the production of an antidote serum. The Parel Laboratory, Bombay, keeps a supply of cobras from which venom is extracted every ten days. The snakes are forcibly fed with egg flip through a tube. The venom is dried over lime and then dissolved in a salt solution. Increasing doses are injected in a horse until at the end of two years the animal can stand a dose 200 times the original one and is quite immune from the cobra poison. The serum from the blood of this particular horse is an antidote and is absolutely effective if injected in time. Many lives have been saved by its use. However, each bite requires an antidote made from the venom of the same sort of snake that inflicted the bite. The Parel Laboratory is working to develop a greater variety of antidotes.

Roentgen Photographs of Plants

MEDICAL science calls such compounds as are impervious to the Roentgen-rays "contrast matters," and therefore, in taking photographs when these sub-



Roentgen photographs of plants.

stances are present, strong shadows are produced. Such matters are used in Roentgen photography for filling hollow bodies that would otherwise not give any distinct pictures.

Naturally, the contrast substances applied to living

A light trap to catch cutworm moth.

organic structures must be of such a nature as not to be harmful to the organism. Such are, for instance, bismuth-carbonate, barium-sulphate, thorium-oxide, and others. Wounds are usually prepared by filling same with dermatol or iodoform. (Iodine gives a very strong shadow.)

The Hungarian scientist, Dr. Adalbert Kelen, performed a series of similar experiments with different plants. The attached picture is one of his Roentgen photographs, and shows an enlarged photograph of a rose leaf in front of which are placed some carnation stems. In his experiments he first prepared the plants by putting them into a solution of 20 per cent potassium-iodide. After a few hours the plant absorbs a part of the solution and is ready for the Roentgen pictures.

The thin parts of the plant would hardly be visible on the photograph without having been first prepared with the potassium-iodide solution.

Naturally, the original photograph shows more perfect details, which are entirely lost by the reproduction and printing.

A home-made static electric machine.

Wanted: One Thousand Aeroplanes for the War

THE well-known English writer, H. G. Wells, wants a corps of a thousand aeroplanes for war service. The war, he says, has evolved two classes of aeroplanes, a light and swift model for reconnaissance, and a heavier and slower machine for bomb throwing. With a sufficient number of flying batteries of this kind, he thinks the Allies would achieve the mastery over earth batteries, which are now practically firing blindfolded. Aeroplane work, Mr. Wells asserts, must remain individual, as it is impossible to transmit orders to large numbers of machines; but he thinks these "flying batteries" should follow bird formation, flying in triangles, one after the other, thus enabling a corps of machines to cover a territory effectively.

A Light Trap to Check the Cutworm

ALARMED by the ravages of cutworms, the beet sugar ranchers of southern California have begun a vigorous onslaught upon the moth that deposits the eggs of the pest. This is a night-flying insect that is attracted by light, like other moths, and the most effective device produced so far consists of a low scaffold which supports a globe containing an electric or acetylene light.

Beneath the globe is a broad pan with oil, in which the moths fall and perish after striking the light. One of these set in the field caught about 1,700 moths in one night, while another, placed upon a beet dump, made a catch of 7,000 insects in a night, and as many of them were egg-carrying females, the number of the pests thus destroyed in a season can hardly be calculated. One of the beet sugar companies maintains eight light traps of the sort shown in this photograph, and the device is of high efficiency.

Quickly Constructed Static Machine

FOR experimental purposes, a small static electric machine is sometimes indispensable, though oftentimes a hard instrument to obtain unless one wishes to invest a considerable sum in a piece of mechanism which, perhaps, will not again be used. Having found it expedient to make use of a machine of this sort, and not caring to purchase one, the author hastily constructed the machine shown in the accompanying illustration, using an ordinary disk phonograph record in place of the glass plate which usually is found on an electric machine. Not having need for the greater efficiency of the influence machine, and having neither the time nor the materials necessary for the construction of one, a very simple frictional machine was made.

The use of the hard rubber, or composition, phonograph record overcame what usually is the hardest part of the construction of such a machine, viz., cutting and drilling a glass plate. The disk was perfectly true and well adapted for the service. To prepare it, it was simply necessary to glue the plate, back down, to a wooden faceplate, mount it in the lathe, and first with coarse sandpaper and afterward with finer abrasives, eliminate the ridges representing the sound waves, and polish the smooth surface. The plate, thus prepared, was mounted on a piece of hard wood doweling, a pair of wooden washers, glued to both plate and shaft with marine glue, serving to insure the attachment of the disk to the shaft. The shaft was mounted, as shown, on a couple of wooden posts set on a base board, and a wooden handle was glued to one end of the wooden shaft. The bearings are simply holes bored of proper size through the posts, and well lubricated with graphite.

Supported on an ebonite rod, held firmly to the base piece by means of a wooden pedestal, is a silk-covered rubber in the form of a fork, between the prongs of which the plate turns, so that the silk padding always contacts with the surfaces of the disk. At the other side, and also supported on an ebonite rod, is a collector ring bearing sharp points which are brought almost in contact with the surface of the ebonite plate. A pair of Leyden jars were made from a couple of fruit jars, turned ebonite covers being provided.

The whole apparatus took but an hour and a half to construct, and the cost was negligible. While it is by no means as effective as a Wimshurst machine, still, under suitable weather conditions, it will give a spark an inch and a half long without the slightest trouble, and can be used very nicely to demonstrate the glowing of Geissler tubes, ignition of gaseous mixtures, etc.

Inventions New and Interesting

Simple Patent Law: Patent Office News; Notes on Trademarks

Fig. 1.

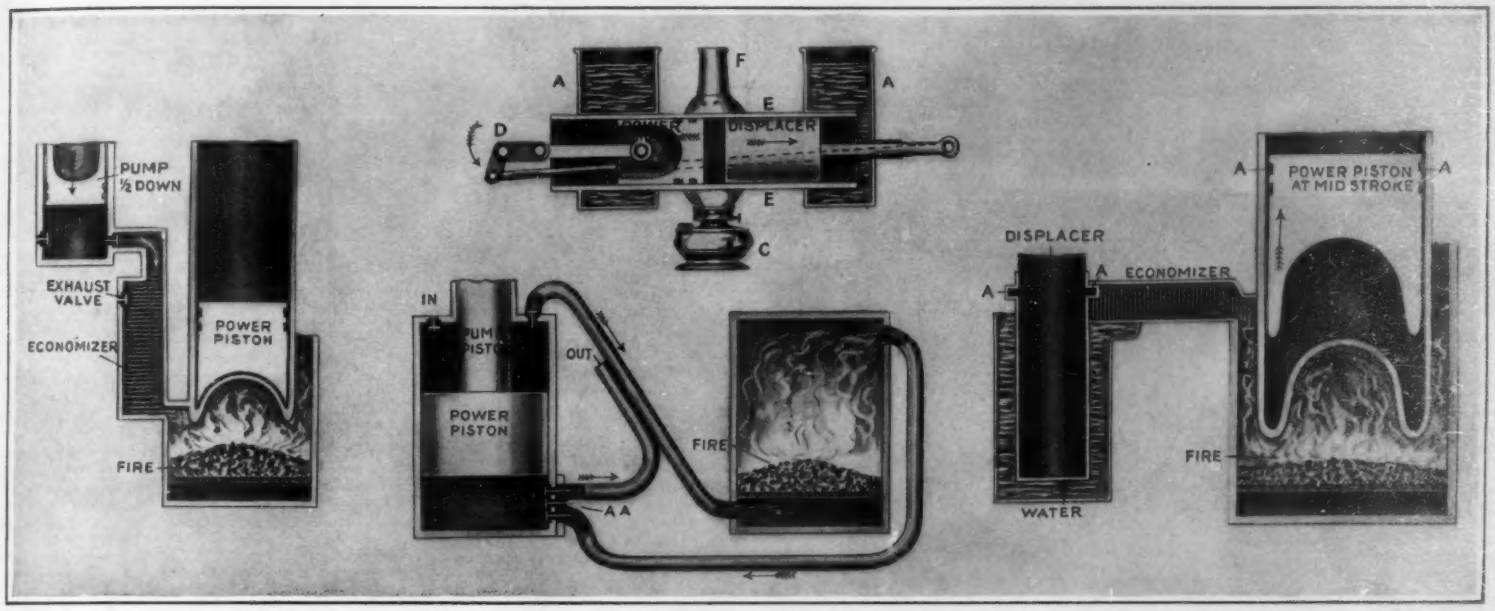


Fig. 2. Fig. 3. Fig. 4.

Types of hot-air engines shown diagrammatically.

In Fig. 1 *AA* are water-hoppers; *C*, the lamp; *D*, crankshaft; *EE*, walls acting as economizer; and *F* the lamp chimney. In Fig. 3 *AA* represents usual steam engine valves. In Fig. 4 *AA* represents packing rings.

The Hot-air Engine

By Charles E. Duryea

THE present generation has grown up under the spell of electricity. Not only has it seen the electric motor spring into being and take up all sorts of work, from driving trains to drying hair, but it has seen the internal combustion engine, largely because of electric ignition, develop into a light, but powerful giant, that has made phenomenal successes of the age-long problems of the automobile and flying machine.

With such brilliant examples of success before them, it was but natural that our inventors and capitalists should confine themselves to these new lines and ignore the older and apparently less promising hot air engine. In this same period, however, several advances have been made of importance to the worker who may wish to use the hot air engine. Better machine shop facilities have made good machine work common and cheap. (The ball-bearing is a familiar example of an obvious device that could not come into common use sooner than it did because no commercial way of making it practically accurate existed.) Better oils are now to be had. The internal combustion engine and the superheated steam engine have demanded high fire-test oils, and wall temperatures of 700 deg. Fahr., or even higher, can now be lubricated without difficulty.

Far better foundry practice is now commercially at hand. A single set of metal patterns mounted on a molding machine will produce a hundred complicated molds in a single day, at a labor cost so low as to be almost negligible. Even the composition of the iron is a matter of knowledge rather than guess, and it is now recognized that some irons stand the distortions of heat far better than others. If in particular places still better materials are needed, the nickel alloy steels offer practical freedom from expansion and contraction, with almost no scaling or corrosion. Finally, we have flameless combustion, using half the air and leaving no free oxygen to scale the hot metal parts. The bane of the early workers was the burning out of the parts exposed to the heat, whereas to-day we protect iron and copper surfaces by alloying them with zinc or aluminium, as in sherardizing or calorizing. This advance alone is sufficient reason for bringing this matter to the front once more. Cooling has been well worked out, and this knowledge can be used. Last, but not least, the market for power is enormous compared to the market twenty-five years ago. Every city of any size has its gas works. Many houses, in the Eastern cities particularly, do not have electricity, and all over the world the need for converting any ready fuel into power is growing stronger. This is particularly true in the warring lands where horses are being killed. Every gas jet, every heating

(Concluded on page 170.)

A Continuous Rod Casting Machine

A MACHINE that does away with the present system of making rods of lead, zinc, brass, copper and aluminium by rolling and that may be made applicable to steel, has been developed in Newark, N. J. It is a small continuous casting machine which with one operation gives results now requiring much labor and fuel and considerable time and space. The process involves a radical change in the rod industry.

The hot liquid metal is transferred from the melting crucibles directly into an endless chain of mold blocks in the machine, where solidification takes place, and the rod comes out continuously in a solid form at one end as long as the molten metal is supplied. The operation of those mold blocks, so as to produce a solid rod of uniform structure, constitutes an important part of the invention, which is thus described.

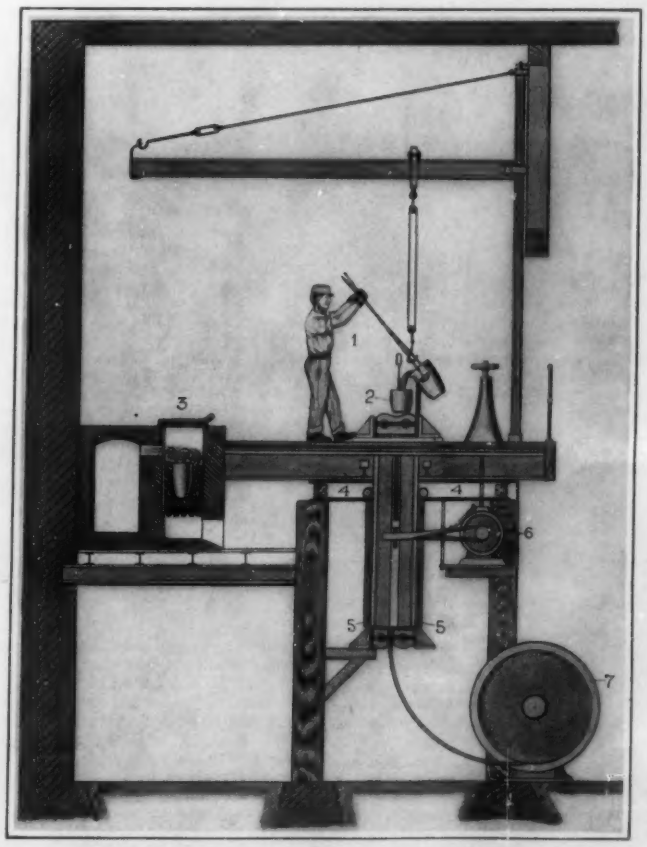


Diagram showing operation of the continuous rod casting machine.

1, Operator pouring metal from crucible into feed basin, 2; 3, melting furnace; at 4 are located water jets and mold cleaning brushes as well as an air brush to apply a mold facing; cooling jets are located at 5; the machine is driven by a variable speed motor 6; and the rod is coiled on reel 7 as fast as produced.

The Vertical Type.

The machine, shown in the illustration, 12 feet in height over all, has a framework of cast iron holding in position two endless chains of mold blocks, which are made in sections and join in center alignment. The molding chains are composed of steel blocks, grooved on one face to form the molding cavity, and linked together with flexible joints. Each block is carried on four rollers which guide the chain around the end sprockets and carry it in its course through the machine.

The accuracy of alignment requisite to the production of a perfect rod in the mold groove formed by these sections is secured by careful machine work, and by building the four ways, down which the alignment takes place, so that two of the sides are fixed permanently, while the opposite sides are held to their position by spring pressure. The guides carrying the molds, while in casting position, are water-cooled square tubes.

The length of this machine is somewhat indeterminate. A certain amount of both time and cooling surface is required to solidify the metal in the mold; and one may either use a long molding chain and run it fast, or shorter chain and run it correspondingly slower. It has been found, however, that with 8 feet length between centers for the chains a casting speed of 25 feet per minute for ⅞-inch brass rod will not cause the molding blocks to rise in temperature above 450 deg. Fahr. Many experiments have shown

(Concluded on page 170.)

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

SAFETY COLLAR BUTTON.—G. B. MANNING, 6 South Missouri Ave., Atlantic City, N. J. In this case the invention has special reference to an improved safety collar button consisting of two sections, designed to be movably engaged and clamp the material of the neckband or other garment between the bases of said movable parts or sections.

Electrical Devices.

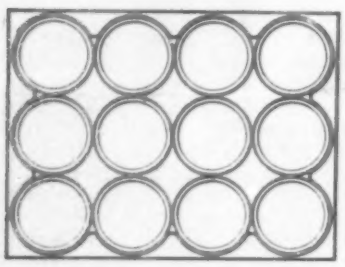
CIRCUIT CLOSER.—I. E. ROSENTHAL, 402 E. 2nd St., Argenta, Ark. This invention provides a circuit closer for electrical fire alarms operated by excessive heat for automatically closing an electrical circuit, to cause the same to actuate an alarm or a series of alarms, as, for instance, bells, automobile horns, electrical whistles and annunciators.

STARTING BOX.—M. TAIGMAN, 241 Wooster St., New York, N. Y. This invention provides for discontinuing the supply of electric current when the retracting element of the switch lever becomes disabled; provides for discontinuing the current supply when the back of the starting box is opened; interrupts the current supply in the event the box cover becomes loosened; and multiplies the current-interrupting effects in the event of the retracting spring of the starting switch lever becoming disabled.

TERMINAL CONNECTOR.—J. A. JONES, 915 Morton St., Anderson, Ind. In the present patent the invention has reference to lamp sockets or other electrical devices to which circuit wires are connected, and the invention relates more particularly to means for connecting the wires to the terminals of a lamp socket or other electrical device.

Of Interest to Farmers.

EGG CONTAINER.—W. H. LEWIS, L. B. 28, Arrington, Va. The invention relates to egg containers more particularly intended for use in shipping by parcel post. The objects are to provide an egg container having cells adapted



EGG CONTAINER.

to conveniently receive separately wrapped eggs, and to provide cells in which the eggs will be fully protected against breakage by the ordinary shocks or pressure to which they are subjected in transit.

EGG AND BUTTER CARRIER.—A. J. COLGHENOUR, M. S. E. Signal Corps, Fort Leavenworth, Kan. The carrier is especially adapted for the transportation of eggs and butter, incandescent light bulbs, bottle goods, and like fragile articles by parcel post, express or the like, wherein an outer casing is provided and an inner carrier or container for the articles, cushioned against the outer casing.

Of General Interest.

INK FEEDER FOR PENS.—F. B. HINE, care of H. R. Gamble, 414 Trust Bld'g., El Paso, Tex. The invention deals particularly with a fountain attachment applied to the hollow of the pen for retaining and feeding ink to the tip of the pen, whereby a large number of words can be written with one dip of the

INK FEEDER FOR PENS.

pen into an ink well. The invention improves and simplifies the construction of ink-feeding devices for pens so as to be reliable and efficient in use and so designed that they can be applied to a pen holder of ordinary construction and admit of a pen being applied or removed without the attachment interfering.

AWNING FIXTURE.—M. DOWLIN, Henniker, N. H. The improvements relate to awnings for windows or other openings, and more particularly to awning frames and the fixtures by which said frames are held to the casing, jamb or other part of a building or structure surrounding and adjacent to said window or other opening.

Machines and Mechanical Devices.

WELL DRILLING APPARATUS.—J. L. DYSON, Loyalton, Cal. This invention refers to drill turners and more particularly to that class of automatic arrangements for this purpose utilized in connection with well drilling operations, and the object is to provide an attachment whereby the desired result may be accomplished through the action of the trip rod and the impact of the drill upon each stroke thereof.

PROPELLER.—H. I. BENEDICT, 218 W. 50th St., New York, N. Y. This invention pertains to propellers for marine and air crafts, and more particularly to a propeller of the oscillatory type in contradistinction to rotary propellers. Its general objects are to improve and simplify the construction of propellers so as to be highly efficient in use and equally effective in both forward and reverse propulsion.

SIGHT GLASS FOR ROUTING MACHINES.—J. W. NELSON, 488 Lorimer St., Brooklyn, N. Y., N. Y. The invention provides a magnifying glass and an adjustable holding mechanism therefor, arranged to permit the operator to guide a relatively small cutting tool with greater accuracy; provides means to prevent the flying of dangerous particles cut from the work being executed; and provides means for augmenting the area of operations of the magnifying member.

DISH FORMING MACHINE.—P. R. SIMMONS, Marion, Ind. This invention relates to a machine for forming paper dishes or pie-plates and more particularly to a machine which is adapted to be used in connection with a rotary cutting device, and to receive the paper therefrom, such a cutting device as described and claimed in the Patent of Mr. Simmons, No. 1,044,931, November 19th, 1912.

NON-OFFSET SURFACE COVERING FOR IMPRESSION CYLINDERS.—J. F. HASKINS, 96 Park Place, New York, N. Y. Among the objects here is to provide a surface covering for an impression or packing cylinder of such nature or character as to obviate the use of the troublesome and expensive tympan sheet so commonly used for receiving and absorbing the surplus oil, ink or smut from the printed sheet.

PRESSER FOOT FOR SEWING MACHINES.—E. W. MATHEWSON, care of J. N. McLean, 1073 Bloor St., Toronto, Canada. The general objects of the invention are to improve and simplify the construction and operation of presser feet having anti-friction devices in the under or cloth-engaging surface so as to be reliable and efficient in use and so designed as to enable the cloth to feed under the foot not only in a straight line, but in any desired direction.

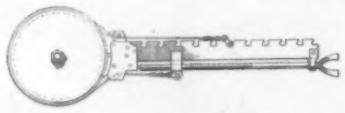
CRUSHER.—A. W. WARSEN, 1440 E. 15th St., Brooklyn, N. Y., N. Y. In the present patent the invention has reference to crushers of the rotary type, and the object thereof is the provision of a simple, strong, inexpensive and efficient crusher in which the translating roller is prevented from vibration during the crushing.

Musical Instruments.

AUTOMATIC VIOLIN.—H. HEGELER, Gaststrasse 23, Oldenburg, Germany. This inventor provides an automatic violin with rotating bowing member, which instrument in the first place presents the advantage that the space occupied by it is reduced to the minimum, as not only the instrument itself, but also the bowing member are arranged horizontally, the latter being located approximately in a plane parallel with the instrument.

Prime Movers and Their Accessories.

PISTON RING COMPRESSOR.—J. A. EIKELBERGER, Bennington, Kan. The object of the invention is to provide a device for compressing the rings of the piston of an engine, as for instance, an explosion engine, to permit the piston to be replaced in the cylinder, and

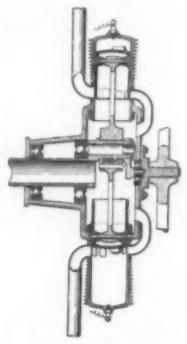


PISTON RING COMPRESSOR.

wherein the compressor in addition to compressing the ring in such manner that it will enter the cylinder also provides a handle for manipulating the piston and the rings.

CARBURETER.—A. GRAPIN and L. GRAPIN, 94 Rue de Longchamps, Neuilly-sur-Seine, Seine, France. The improvements in this case consist essentially in the use of a set of narrow jet channels vertically arranged in one vertical wall, such channels communicating at the bottom with a fuel container and communicating higher up, on one side, with a supply inlet for the atmospheric air, and, on the opposite side, with a sucking chamber connected with the combustion chamber of the engine, the communication of the said channels with the sucking chamber being located higher up than their communications with the atmosphere.

TWO CYCLE ROTARY CYLINDER ENGINE.—J. B. ORTHOLAN, care of Bowring & Co., 17 Battery Place, New York, N. Y. The essential feature of the present invention consists in utilizing the centrifugal force as main agent for the discharge of the combustion gases and



TWO CYCLE ROTARY CYLINDER ENGINE.

for the admission of the explosive gas or mixture in a regular and perfect form during the cycle of each one of the cylinders, by which means a maximum of regularity and efficiency in the working is obtained.

Railways and Their Accessories.

BRAKE FOR RAILWAY CARS.—E. CASTANHO, Rua Liberade 644, San Paulo, Brazil. The invention relates to a brake that is to be used upon a track rail. It consists of brake shoes arranged to engage opposite side of the rail being drawn together by means of a right and left-hand screw which is turned by a chain and sprocket gear. Two such brake mechanisms operating on opposite tracks may be controlled by a single sprocket chain.

METAL AND CONCRETE RAILWAY SLEEPER.—J. T. CARNEY, Rio de Janeiro, Brazil. The object of this invention is a new type of sleeper, of metal and concrete, for railroads and the like, of very simple construction. The principal portion of the sleeper is its metallic part on which the chairs for the rails are directly fixed, and it is for that reason that it is said that the sleeper, according to the invention, is a "sleeper of metal and concrete" and not a "sleeper of reinforced or armored cement."

Pertaining to Vehicles.

HYDRAULIC BRAKE MECHANISM.—F. H. TREGO, Springfield, Mass. The invention relates to a brake mechanism of the hydraulic type, and is especially adapted for use in connection with trucks of large tonnage on which hand-operated brakes are unsatisfactory, in that they cannot be applied without undue effort on the part of the driver.

FOLDING BACK ATTACHMENT.—H. W. WEED, 21 4th St., Stamford, Conn. This invention provides a folding back attachment for motor cycles, bicycles and the like, whereby the folding back can be conveniently and securely attached to a seat, and the back can be readily swung into an approximately horizontal position for mounting or dismounting purposes, or into an upright position for supporting the back of a rider.

AUXILIARY CAR FOR MOTOR CYCLES.—G. HAVENSTEIN, care of Western Builders' Supply Co. Agents, 155 New Montgomery St., San Francisco, Cal. This device may be attached to a motor cycle, wherein a frame is provided supported at one end by a pair of wheels and having means at the other end for permitting the said end to be connected to the motor cycle frame to support the rear wheel thereof out of contact with the ground, and having driving mechanism arranged to connect the rear wheel of the motor cycle with the supporting wheels of the auxiliary car, and wherein the connection between the rear wheel and supporting wheels is under control of the rider.

TRANSMISSION GEARING.—B. MAYER, Paymaster, U. S. N. Address U. S. S. "Dixie," care of Postmaster, New York, N. Y. The invention relates particularly to the transmission gears of automobiles and motor cars, the object being to provide certain improvements, including a gear train, which is always in mesh, together with positive means movable through a portion of the gear train and adapted to connect the gears either progressively or selectively, and also including novel reversing and direct drive features.

DOUBLE ACTING LEAF SPRING.—A. TRAVIS, Box 228, Brewster, N. Y. This inventor provides a leaf spring more especially designed for use on automobiles and other vehicles and arranged to take up strains in both a downward and an upward direction, thus acting as a shock absorber by taking up all jolts and jars whenever the vehicle wheels pass over gutters or obstructions in the roadway.

SNAP BUTTON.—A. J. DIECKMANN, Room 510, Wiechman Bldg., Saginaw, Mich. This button is adapted for use in connection with eyelets, of the class used upon vehicle curtains, etc., and the invention provides such buttons which consist of two members jointly forming a head, means for normally maintaining said members separated in a resilient manner, and means for connecting the same to a curtain or the like, said head being adapted to be forced through an eyelet in another curtain element.

RESILIENT WHEEL.—J. J. ZIPAY, Great Falls, Mont. The invention relates more particularly to an improved resilient automobile wheel. One of the principal objects is to provide an improved wheel having a puncture-proof tire, within which is resiliently supported and balanced the wheel hub and adjacent parts.

REVERSIBLE FOLDING BABY CARRIAGE.—O. O. RICHARDS, 275 Barclay road, Birmingham, England. This invention relates to folding baby carriages in which means are provided whereby propulsion can be effected from either end of the car. It mainly consists in such a carriage with a single toggle joint such as that used on a perambulator or like hood connecting the frame to the handle in both the position for forward driving and for driving from the opposite end.

TIRE.—C. E. ROBINSON, G. W. YOUNG, and J. B. F. SHOWALTER, care of the last, 13 Jefferson Theater Bld'g., Springfield, Mo. In the present patent the invention has reference to improvements in tires, and particularly to an inner tire or subcushioning member, and has for an object the provision of an improved, simple, strong and resilient structure adapted to prevent punctures and rim cutting.

ANTIDRIP SUBFRAME FOR VEHICLES.—R. H. BACHMAN and F. H. BACHMAN, 321 Commonwealth Bld'g., Allentown, Pa. The invention relates to a vehicle having means to receive drip from the body of the vehicle and protect the vehicle parts beneath, including, in the case of automobiles, the gearing, etc. An object is to provide a subframe and drip pan attachment so arranged as to be applied to vehicles of standard makes, without any material alteration therein, and to be interposed between the chassis or frame of the vehicle and the body.

AUTOMOBILE SAFETY BRACE.—E. J. WEAVER, 67 S. Vine St., Westerville, Ohio. The improvement provides a brace against which one of the wheels of an automobile may be rolled and secured, in order that the automobile may be prevented from accidentally rolling down hill or moving from a stationary position, the brace being adapted to be locked upon the wheel, so that the automobile cannot be stolen.

HEADLIGHT.—R. F. WILSON, 403 Sugar Bld'g., Denver, Colo. The primary object here is to provide a light in which the blinding effect of its reflected rays on pedestrians and operators of approaching vehicles is mitigated by means which permit the independent operation and focusing of the adjustable upper and lower portions of the reflector employed.

Designs.

DESIGN FOR A SCRIP STAMP.—E. L. LOWE. Address National Trading Stamp Co., New York, Moorhead, Minn. In this ornamental design for a scrip stamp the figure shown is a plan view of the stamp.

DESIGN FOR A TIRE.—H. W. RAYMANN, 114 Floral Ave., Portland, Ore. In this ornamental design for a tire, one figure shown gives an edge view of part of the design, and the other gives a side view.

DESIGN FOR A SCHOOL DESK.—S. MAC C. JONES, Box 76 Wilkinsburg, Pa. In this ornamental design for a school desk the article is represented in a side elevation which shows a desk of attractive and highly original form.

DESIGN FOR A PENCIL.—E. J. DUKES, care of Aiken-Lambert Co., 47 Maiden Lane, New York, N. Y. The figure shown in this case represents a side view of a very simple yet attractive design of a pencil.

DESIGN FOR A KNIFE FOR TABLE USE AND OTHER PURPOSES.—A. W. COX, 76 Summer St., Malden, Mass. In this ornamental design three figures are shown: The first is a plan view of the knife embodying the new design; the second is a side elevation thereof; and the last is a cross section on a line of the first figure.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee; title of the invention, and date of this paper.

First Quality Car at $1350

New Motor — New Car — New Price — New Service to Owners

Increased Factory Facilities—Quadrupled Production for 1916

TWO years ago we saw three things. First was that the tendency of the public demand in both Europe and America was to a compact high speed motor that was more efficient, would get away quicker, run more smoothly, have greater flexibility, show greater economy and last longer under hard service.

Second was that a public temporarily diverted to cars that looked well and rode nicely for a while, would swing back to demand quality manufacture and the ability to "stay put."

Third was that only those manufacturers who built their own cars in large volume and bought their own materials for spot cash at the advantage of the market could survive.

Motor Designed in Europe

So we sent our engineers to Europe to design a new motor and began to lay our plans for a production of 20,000 cars this season.

Twenty thousand cars! Nearly four times as many as the Chalmers factory ever turned out before! We are now building two big new factory additions to handle the work. We added machines that cost $72,000 apiece to do work in our factory in order to give this remarkable quality car to you at $1350.

Here is the result.

No one dreamed that such a car could be built for $1350. It is equal to cars that sold for $4000 three years ago. It isn't a made-over model, reduced in size, or certain things eliminated to fit the price—it is a brand new car, designed specially as a Quality car at a low price.

The Quality Car at Small Profit

We are marketing this QUALITY car on the lowest profit per car in the motor car business.

The great valve-in-head motor, with overhead camshaft, costs us $80.00 more to build in our own shops than the ordinary type of motor can be bought for on the outside, and most of the competitors in our price class are using the ordinary type of motor.

When Chalmers engineers went to Europe to study design two years ago, they found European designers at work on high-speed motors of the valve-in-head type with overhead camshaft.

European makers had already tried this type out in their racers. They were perfecting it for a road car.

We hoped to be the first in America to adopt this style of motor. But when the war stopped European makers — fate decreed that we should lead the world in the use of the valve-in-head overhead camshaft motor for a stock car.

Speedway Racers All of This Type

We were not surprised at the showing at Indianapolis and Chicago, where this type of motor won all honors. We knew a year ago that these results would be achieved. We knew that to attain a speed of 90 to 100 miles an hour that the motor would have to be a valve-in-head, overhead camshaft type.

Think of it! 90 miles an hour for 500 miles at Indianapolis and eight of the first ten to finish were valve-in-head motors, with overhead camshafts!

And then the Chicago races at 100 miles an hour for 500 miles—the first three and seven out of the first eleven were of this type!

Some one said a short time ago that people buy motor cars largely on three P's — Paint, Price and Performance. You can measure this Chalmers wonderful car, at $1350, by any one of these three standards. It is right in Paint, which indicates finish and wearing qualities.

It is right in Performance, because no car at any price performs better than this car does.

And it is right in Price. No one in the history of the industry ever approached such quality at such a price before.

Take a Ride in This Car

"Take a ride in this car," and see for yourself if you do not get in this Chalmers type of six-cylinder motor all the smoothness, all of the flexibility, all of the pick-up, and all of the "pep" that is claimed for any other motor built, no matter how many cylinders it may have.

Therefore, we say that all of our strength, all of our organization, all of our money, all of our reputation, are back of these six words: "TAKE A RIDE IN THIS CAR."

Demonstrators are now in the hands of our dealers.

"TAKE A RIDE IN THIS CAR."

New Service to Owners

Buying a motor car without a definite guarantee of service is unwise and costly. Every Chalmers dealer gives to every buyer of a Chalmers car a *definite service* free of all charge.

This service consists of an Universal Interchangeable Service Coupon Book, each Coupon being exchangeable for a definite amount of work at any Chalmers dealer's anywhere at any time.

Quality First

The Chalmers Club

Every Chalmers owner is invited to join the Chalmers Club.

Each member receives regularly without charge "The Chalmers Clubman," a magazine devoted to the interests of Chalmers owners. Also a membership card signed by Mr. Chalmers, commending the owner to the courtesies of all Chalmers representatives everywhere.

"Let your next Car be a Chalmers"

Chalmers Motor Company
DETROIT, U.S.A.

A Continuous Rod-casting Machine

(Concluded from page 165.)

that in the casting of bronze mixtures, the pair of molding blocks should have about six times as much sectional area as the cast rod, to allow a reasonable temperature difference for the rapid removal of heat.

The first machines designed for this process of continuous casting were vertical; but the desire of practical rod-mill men to operate with the molding groove horizontal led the inventor to spend considerable time in experimental improvements of the mechanical details, in order to secure a maximum efficiency for the horizontal machine. In this attempt, numerous troubles and intricate problems were encountered. The machine would always cast rods; but its successful operation in a horizontal position required more skill than that of an ordinary laborer. After much experiment the axis was first made slightly inclined; but finally the vertical position was readopted; and in this form one laborer, with a little preliminary instruction, can manage the machine without difficulty.

The chief hindrances to horizontal operation were: The difficulty of completely filling the molds, and the circumstance that, in working horizontally, the lower chain did the greater part of the work and became, after a time, excessively heated, while the upper chain remained relatively cool. This caused an irregular structure both in the cast rod and in the drawn product resulting therefrom; and as a result the required strength tests were not satisfactory. In the vertical arrangement these difficulties automatically cured themselves since the metal completely filled the mold, with uniform contact all around, thus causing each portion of the chain to do its work, and giving a symmetrical structure to both rod and resulting wire.

The flow of metal into the machine is controlled by an electrically operated automatic device, which adjusts the feed to the speed at which the machine is operated. If for any reason the machine should stop, the flow would be automatically shut off. A safety device is incorporated into the drive, so that if any foreign material clogs the chain a safety pin is sheared, thus protecting the mechanism from injury. The rods are delivered from the machine immediately to the die of the bull block, where they are drawn down to suit particular orders.

Advantages Gained.

This new method of manufacturing rods does away with the following steps of the old system: Casting the wire bar; handling the wire bar from the molds; rehandling the wire bar to and from the reheating furnace; reheating the wire bar; and rolling the wire bar.

It also eliminates the loss from oxide scaling during heating and rolling. Since the power required to run this machine is only about 5 horse-power, the cost of large engines, boilers, etc., is practically done away with. The labor cost of this process is but 5 per cent of that of the old method, the caster being the only workman required.

Casting rods of lead and soft-metal alloys is the first step in the manufacture of shrapnel bullets; and the machine will cast per hour enough lead rod for more than 200,000 bullets. The only motive power required is that which is necessary for overcoming the friction resisting the motion of the traveling mold chains, which is in the neighborhood of from 2 to 3 horse-power.

Aluminium rods are produced with diameters ranging from ¾ inch upward.

The Hot-air Engine

(Concluded from page 165.)

or cooking plant has waste heat that is a potential source of power which should be utilized. Fans, sewing machines, suction cleaners, washers, freezers and refrigerating pumps are among the household needs, not to mention the many shop uses. The hot air engine has neither carbureter nor ignition devices and so has a simplicity that commends it for such service.

The best known form of engine, invented in 1816, uses the same air over and over, either at atmospheric pressure or compressed; in the latter case having a storage tank to supply any loss, while a simple check to admit air serves in the case of any loss in the atmospheric pressure type. (See Figs. 1 and 4.) Two pistons of different capacity (diameter or length of stroke) are used, of which one does the work and the other simply displaces the air from the cool to the hot end of the cylinder and back. The cranks are set about 90 degrees apart, and the engine will run in the opposite direction if the displacer crank is set at the opposite side of the center. The best position for any construction seems preferably found by trial.

Several arrangements are possible. For the simplest toys (Fig. 1) the cylinder is often of double length, with the worker piston in the open end, the heat applied at the middle and the displacer at the closed end, which is cooled.

The displacer has some length so as to separate widely the hot and cool portions, and it is hollow so as to be light, being usually carried on the piston rod in the small sizes. As the air flows from the hot to the cool end it passes through wire screens or other porous metal masses, which absorb the heat and may then pass through a water jacket for further cooling. When the displacer starts in the opposite direction, the cool air flows back through the "economizer" and picks up the heat in reverse order. This partly expands it, while the heat applied to the hot portion does the remainder. While it is very common to make the displacer of less capacity than the worker piston, in some forms it has been larger, the aim being to get a greater difference between high and low pressures by exposing a larger proportion of the contained air to the heating and cooling.

A second form is shown in Fig. 2. It uses a small capacity piston to pump air through the economizer into the heated head of the working cylinder. This air at the same (pump) pressure, but in expanded volume, drives the worker piston and then is exhausted through the economizer. Valves are required to secure this action, whereas the type described above has none. By setting the pump piston slightly ahead of the worker, the work does not begin till the pressure has risen considerably and continues expansively after the pump has stopped. The unusable space in the economizer is objectionable; more so than in the type first described, because any pressure remaining in it has done no work, and is wasted when the exhaust opens. Both the above types heat from the outside, and, therefore, were considered slow speed affairs, but having seen the internal combustion engines speeded from five to ten times what were considered workable speeds twenty years ago, we should at least take hope for the hot air engine.

The type shown in Fig. 3 offers even more promise. It uses the pump to send air through the economizer to the fire and thence the products of combustion, increased both by the heat and the gasification of combustion, pass to the worker piston, after which they exhaust through the economizer. The economizer in this case should be partitioned so that there need be no valves in connection with its use, the incoming air flowing on one side of the partition and the heat flowing through the metal from the outgoing exhaust on the other side. With some restriction at the economizer outlet the heat of the exhaust should be pretty fully taken up by the economizer and not lost by expansion to atmosphere. The pump piston need bear no relation to the working piston if the combustion chamber is relatively large. In such case it is simply a reservoir of gas under pressure and the working piston may cut off at any portion of the stroke and work expansively as does a steam engine. It may be high speed, compound (high and low pressure) or composite (reciprocating and turbine) and can be self starting and reversing. It is much a question whether or not in these days of eight and twelve cylinder gas engines, with electric starters and electric speed changers, a reversion to some original type of this kind would not work wonders in simplification and increased handiness and economy. The flameless internal combustion burner would seem to be admirably suited to this type. With careful insulation very little heat should be lost. The great trouble has been burning out of the parts because of uncontrollable heat; but so perfectly can heat be controlled nowadays that this is regulatable, while internal cooling could be added which would make use of some of the heat otherwise wasted. The advantage of any gas as an expanding medium, over water (which takes much heat to convert it into a gas, which heat is not recoverable), is well known. This last form of air engine has received some attention in connection with gas turbines; successive charges of combustible mixture being exploded in a closed chamber, the only moving mechanical part being a check valve.

Edible Wood

THE scarcity of food and animal fodder which the war has caused has compelled the Germans to look about for substitutes, among which wood naturally presents itself. The idea of using wood as food is not new. In famines and sieges the supply of flour has often been eked out by the addition of ground bark and sawdust. In the great famine of 1816 and 1817 the chancellor of a German university experimented with wood, and published an article on the art of making bread of wood.

Prof. Haberlandt has recently made a thorough study of the food value of wood. He has found, according to *Prometheus*, that the wood of trees constitutes, to some extent, a reserve supply of material, and that it contains, especially in winter, large quantities of sugar, starch and oil, and small quantities of albumen. These foodstuffs are found only in living wood, i. e., in the sapwood, twigs and branches, not in the heartwood of the trunk. Soft woods, such as pine, birch and linden, contain much oil, but very little starch, while hard woods contain a large amount of starch, from ⅓ to ¼ of their bulk, consisting of starch-yielding tissue.

It is evident that the eating of wood introduces into the stomach a great quantity of indigestible matter, from which the digestive organs can extract the nutriment only if the cells of the wood have been broken by very fine grinding. Pine and spruce are too resinous for food, and oak and willow contain too much tannin. Maple, poplar, elm, linden and birch appear to be the woods which are most suitable for food. It is too early to decide to what extent wood can be used as food. Of course it would be absurd to make bread entirely of wood meal, but a small proportion of this might be added to the flour. It seems quite possible, however, that wood may be utilized as fodder for animals, if the cost of grinding the wood to the very fine condition which is necessary for digestion is not too great in proportion to the food value.

Windmills Where Hurricanes Prevail

THE tremendous force and velocity of the winds prevalent in the Sahara render it impossible to capture their energy by means of the ordinary windmill, such as those which form so familiar a feature of the landscape in Holland. The Italians at Tripoli, however, have succeeded, according to a note in *Technische Monatshefte* (Berlin), in overcoming this difficulty by constructing windmills of special design.

"The wind-wheel consists of five very strong but extremely narrow wings or blades. In consequence of their narrowness these wings are very far apart and catch only a small part of the wind. The wheel is mounted on a steel tower, whose construction is likewise adapted to cope with the high velocity of desert storms."

NEW BOOKS, ETC.

ELECTRIC LIGHTERS AND STARTERS FOR AUTOCARS. By Harold H. U. Cross. New York: D. Appleton & Co., 1915. 12mo.; 282 pp.; illustrated.

The wide and increasing interest manifested in electric lighting and starting has inspired the author to offer a handbook frankly intended for the everyday motorist, in which the whole subject is handled in a manner "calculated to avoid scaring him by taking him out of his technical depth." The requirements of car lighting are plainly set forth, and typical generators and accessories are displayed by illustration. Engine starters and gear shifts are then taken up; here again the explanations are lucid and the cuts and diagrams clear. That the needs of the technical reader might not be entirely overlooked, several more advanced types of automobile dynamos are dealt with in a more detailed manner.

THE AMERICAN MANUAL OF PRESSWORK. New York: Oswald Publishing Company, 1911. 4to.; 156 pp.; illustrated.

In this attractive work we have a manual avowedly planned for the men of the press-room in contradistinction to the type designer and the compositor. Each phase of the subject is handled by a specialist in that particular branch. The development of the printing press, from its invention up to and including the present complicated and highly efficient forms, is entertainingly discussed, as are also such subjects as inks, color mixing, and register. There are hints for platen press apprentices, a review of the system in a large press-room, and chapters on electrical equipment and gas engine drive. Information of the most diverse kind, but all having in common the quality of usefulness, is simply imparted, and is interspersed with admirable color productions from various processes. The old hand, as well as the apprentice, may find in the volume a new inspiration and increased efficiency.

EUROPEAN POLICE SYSTEMS. By Raymond B. Fosdick, former Commissioner of Accounts, City of New York. New York: The Century Company, 1915.

This excellent study of European police systems, made by Mr. Fosdick for the Bureau of Social Hygiene, serves the useful purpose of clarifying our ideas of what police organization ought to be. We all know that politics play far too great a part in the police affairs of American cities, but after reading Mr. Fosdick's monograph, one is also impressed with the idea that there are other phases which deserve consideration. It becomes immediately apparent, for example, that the heads of our American police departments are as a class not comparable with similar officials abroad. In every large European city the prefect or commissioner of police, whatever his title may be, enjoys a prestige and occupies a social position comparable with that of a cabinet minister. Even the officers who are in direct command of the police may well be compared in dignity with our own army officers; indeed, they have themselves often been army officers and are very frequently university graduates. One leaves Mr. Fosdick's book with the impression that the general tone of a European police system is better than ours. On the other hand, it owes what success it has to the intimate relationship of the state with the police system, something quite lacking in the United States. After we have swept away the incubus of the politician from our police force, there can be no doubt that the revelations which Mr. Fosdick makes must be of the greatest help in placing our police organizations upon a proper footing.

THE HOME OF THE BLIZZARD. Being the Story of the Australasian Expedition, 1911-14; by Sir Douglas Mawson, D.Sc., B.E. Illustrated in color and black and white; also with maps. London: William Heinemann, 1915. 2 vols., 8vo. Price $9 net.

We do not intend to "review" the story of Sir Douglas Mawson's antarctic expedition, which, in two sumptuous volumes, has recently issued from the press. Such a task, properly executed, would almost amount to publishing a special Mawson number of the SCIENTIFIC AMERICAN. Moreover, we should be loth to supply to those persons who are in the habit of getting their knowledge of current literature and the factitious reputation of being well-read from the perusal of book-reviews a short-cut acquaintance with Mawson's work, thus saving them the necessity of buying the book itself. Every copy sold helps to lighten the load of debt—amounting to some forty-four hundred pounds sterling—with which the expedition found itself saddled when the explorers finally emerged from the Antarctic, where their stay had been protracted a year longer than the original plan—and budget—provided for. Not only the royalties on the sale of the book, but also, it is understood, the proceeds of Mawson's lecture tour, are to be devoted to the object of making up this deficit. The task of collecting funds for publishing the scientific results of the expedition, estimated at £8,000, has not even been begun. Big books of polar adventure, entertainingly written, admirably printed, and replete with fine photographic illustrations, are not uncommon. The Shackleton, Amundsen, and Scott expeditions all brought forth such fruit, and in each case the record contained features of unique interest. What, then, is the special claim of Mawson's "Home of the Blizzard" upon our attention? The title of the book suggests an answer. The Australian explorers carried out their work in the severest climate known to prevail anywhere on the globe. Amundsen's party "romped" to the pole (if we may be pardoned this race-track expression) in delightfully tranquil weather. Poor Scott, it is true, perished in a blizzard, but at least half his explorations were carried out under favorable atmospheric conditions. Broadly speaking, the interior of the antarctic continent is a land of calms and gentle breezes, while its periphery is swept by almost incessant gales of astonishing violence. Mawson's field of operations lay wholly within this blizzard-swept region. He and his comrades became used to having their goods and chattels blown helter-skelter out to sea, and soon acquired the novel art of "hurricane walking," which involves leaning on the wind at an angle of about 45 degrees to the vertical. Indeed, they were lucky when they were not obliged to advance on all-fours. All this in temperatures ranging down to 35 degrees below zero, and in an atmosphere charged with blinding snow. Such were the conditions under which these intrepid men carried out explorations through 60 degrees of longitude and made a larger addition to the map of Antarctica than had been made by any previous expedition. In his book, as in his lectures, Mawson is the impresario of the penguin *par excellence*. Thanks to him this droll bird has become as familiar to Americans as the Teddy bear. A minor novelty of his book is the introduction of colored plates produced by the Paget process of color photography. On previous occasions we have protested at the liberties Mawson took with the name "Wilkes Land." If, however, this long strip of coast south of Australia must have a new name, we should like best to see it called "Mawson Land."

EVERYMAN'S LIBRARY. Cloth, 35 cents; leather, 70 cents.

Twenty-one new volumes have just appeared in Everyman's Library. They are:

701. The Life of Robert Browning. By Edward Dowden.

702. Caesar's Gallic War and Other Commentaries. Translated by W. A. McDevitte. With an Introduction by Thomas De Quincey.

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705. Short Studies. By James Anthony Froude. In two volumes.

706–7. The Story of a Peasant. By Erckmann-Chatrian. Translated by C. J. Hogarth. In two volumes.

708. The Subaltern. By Rev. George Robert Gleig.

709. Windsor Castle. By Harrison Ainsworth.

710. Tom Cringle's Log. By Michael Scott.

711. Poor Folk and the Gambler. By Feodor Mikhailovich Dostoieffsky.

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714. British Historical Speeches and Orations. Compiled by Ernest Rhys.

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717. Heimskringla. The Olaf Sagas. By Snorre Sturlason. Translated by Samuel Laing. With an Introduction and a Foreword by Jno. Beveridge.

718. Rights of Man. Being an Answer to Mr. Burke's Attack on the French Revolution. By Thomas Paine. With a Preface by the Author and an Introduction by George Jacob Holyoake.

719. Bacon's The Advancement of Learning. With an Introduction by G. W. Kitchin, M. A.

720. Travels in France and Italy During the Years 1787, 1788 and 1789. By Arthur Young. With an Introduction by Thomas Okey.

721. Tales of Ancient Greece. By Sir George W. Cox, Bart.

There is nothing in the publishing annals of America or England which can quite compare with this enterprise. The whole project of presenting in cheap, readable and attractive form the classics which have had an influence upon the world's thinking is one that must surely commend itself to everyone in these days of cheap and shoddy literature.

WAR'S NEW WEAPONS. An Expert Analysis in Plain Language of the Weapons and Methods Used in the Present Great War. By Baron Hrolf von Dewitz. With Introductory Preface by Hudson Maxim. New York: Dodd, Mead & Co., 1915. 12mo.; 295 pp. Price, $1.50 net.

Baron Hrolf von Dewitz, a subject of Denmark, very naturally views the present European conflict with the eyes of a neutral. He has endeavored to present facts as he has found them, and without partiality, and his handling of the specialized branches of modern warfare and weapons is that of a military expert. He has the masterful knowledge of military tactics and the philosophy of warfare. There are chapters dealing with "Aircraft," "Artillery," "Automobile Artillery," "The Submarine," "The Capital Ship," "The Turret Fort," "The Wireless Signal," "The Super-Commissariat," and "Super-Strategy." He also has a chapter entitled "The Fountain Pen," which is hardly worthy of serious attention in a book of this kind. This book separates from a mass of rumor and misinformation the facts about the various subjects mentioned. It will go a long way toward answering the questions which occur to any intelligent person. The book is a model of clarity and practical value and interest. The author possesses the secret of imparting technical information to a non-technical reader in a clear and interesting manner.

CREAM TOASTS. By Fred Emerson Brooks. Chicago: Forbes & Co., 1915. 16mo.; 94 pp. Price, 50 cents.

The author of "Old Ace" here presents us with a book of original toasts, anti-alcoholic, but by no means insipid. In spite of their deficiency in alcoholic content, most of them possess that "punch" which the literary bias of the hour demands.

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Inquiry No. 9450. Wanted the name and address of a manufacturer who can build a light simple motor for light automobiles and for portable farm work.

Inquiry No. 9451. Wanted the name and address of a manufacturer of machinery for making egg albumen.

A STATEMENT

from THE WHITE COMPANY *to* MOTOR CAR BUYERS

IN view of the confusing market which confronts motor car purchasers, many are looking to this company for an expression of its attitude toward the innovations in mechanical design and new price levels now being announced. We therefore take this occasion to state our beliefs and purposes, which are based on fourteen successful years of experience.

We believe the four-cylinder motor is to be the standard and ultimate type. We therefore consider it wiser to continue perfecting this type of motor, which we have already spent years in developing, than to step abruptly into a field of design that is new to the entire automobile industry, and thus impose an experiment upon our customers.

With reference to price, the White policy will be as it always has been—to build cars to the White standard rather than to a standard that would make a cheap price possible. Materials and labor cost more now than ever before—consequently, lower prices must and do indicate compromised quality.

We hold it as a first principle of our duty to purchasers of White Cars to make a product that will give maximum service with the least amount of attention and of expense for operation and maintenance; a product of such quality and approved construction that it will command high value at any time the owner may wish to dispose of it; in all, to build motor cars which the owners can truly regard as investments.

White policy will always be governed by consideration for the ultimate service-value of White Cars. We will not take part in the spectacular methods, adopted solely for sales stimulation, which prevail in the motor car market at the present time.

In short, the stability of policy which has always meant security to White owners will continue. We neither consider it good business nor do we find it necessary to repudiate the design nor to depreciate, unnaturally, the value of cars which have been purchased from us, by making frequent radical changes in design and price.

THE WHITE COMPANY
CLEVELAND

Cadillac
Standard of the World

—and the Cadillac "Eight" stands all alone

Do you wish to know how good a car this new Cadillac is?

Follow your own thoughts.

You will find that you are thinking what the nation is thinking.

Look back a little bit.

A few years ago the storm raged around the Cadillac.

A dozen or more cars sold at approximately the same price.

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And in the center, as solid as a rock, the great Cadillac clientele—greater, and stronger, and more solid than ever.

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It is not likely.

And yet many a man in past years has thought that he was buying a car as good as the Cadillac, because he was paying an approximate price.

He cannot think that now, because these cars have removed themselves from the Cadillac field.

The storm that once raged around the Cadillac still rages,—but it is in another zone. The Cadillac is out of it, and above it.

In its own great quality class the Cadillac stands alone—all alone.

The Cadillac owner does not believe that its equal exists.

And if ***you*** are looking for its equal—where will you look?

You must first find a car of equally fine construction.

If you search for equality with the Cadillac, where else will you find such workmanship?

Again—in your search for a car equal to the Cadillac, you must find a car of equal experience in V-type engine construction.

The Cadillac has brought the V-type principle to a state of comparative perfection in the building of 13,000 V-type eight cylinder cars.

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—and social pre-eminence,

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—the enthusiastic endorsement of 13,000 owners,

—mechanical construction representing the highest type of fine manufacturing extant,

—and an established record of luxury, long life and endurance.

We repeat—you ***know*** that you get these qualities in the Cadillac.

Where else could you get them?

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